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By Irwin H. Cornell

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A prominent Arizona copper metallurgist

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A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

June 2, 1923

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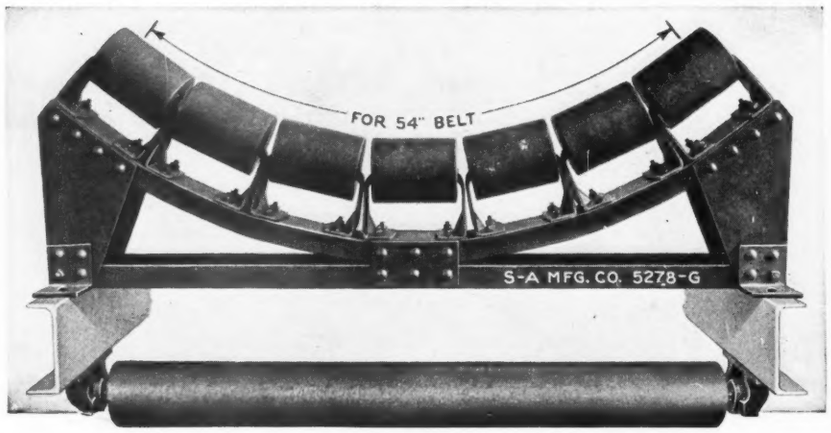

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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Simplicity in Metallurgical Planning

TOO MUCH EMPHASIS cannot be laid on the necessity for the adoption of simple methods in metallurgical planning. However, there is apparent simplicity and real simplicity, and it is advisable that precautions should be taken to distinguish the one from the other. The flow sheet offers no evidence that simplicity has been attained. What appears to be a complicated flow sheet may prove to be practicable, "foolproof," and simple to operate; another may seem to be the last word in metallurgical simplicity, whereas in practice it involves mechanical troubles sufficient to insure disaster to the enterprise.

Flow sheets, like statistics, may mislead. When considering the question of economical operation it is as well for the operator to study the process in detail, to see if attention has been paid by the designer to all the essentials of continuous and satisfactory operation, as well as to the less-important problem of apparent simplification. Much grief has resulted in the adoption of one machine to do the work of two or three units of efficient apparatus.

Intermittent operation implies intervals of freedom from reliance on mechanical equipment. Continuous operation may involve the necessity for the provision of duplicate machines. Thus it is being recognized that primary breaker capacity should be sufficient to handle all the ore required per day of twenty-four hours in one eight- or ten-hour shift; ample time is thus available for maintaining the equipment in first-class condition. Further, operating supervision can be confined to one or two shifts only. A simplified flow sheet might show no ore bins between the primary and the secondary crushers, but such a plan would invite trouble. Continuous milling is logical and practicable, as is also continuous operation of metallurgical equipment that effects the mechanical separation of mineral from gangue and the treatment of finely ground material.

In wet-chemical work, however, although the underlying principle of continuity is desirable and attractive, its application in practice may introduce factors that influence adversely the net economic result. It is being realized that continuous operation involves the costly procedure of maintaining the insoluble material in movement or suspension at all times until discharge. Further, under such conditions, time for treatment is limited; hence the need for excessive comminution in some instances to expose the soluble material to the action of the solvent, with additional problems of separating valuable solution from a finely ground ore or gangue. Here again, simplicity cannot be gaged by a glance at the flow sheet, but rather by an examination of results over an adequate period of time. Continuous-operation equipment is always the simplest and the best when it is self-sufficing and elastic enough to handle an occasional overload, when economic as well as metallurgical results are satisfactory.

Costs of Mining

IS THERE SUCH A THING as temperament in mining? We are inclined to think so, especially after studying the spring literature of mining companies —the annual reports of operations. Once again we must comment upon the liberality of some corporations in making public vital details regarding their work, and emphasize the close-mouthedness of others. In fact, it is difficult to understand from the reading of some financial reports, with their meager information, how they are able to maintain the confidence of their stockholders—but they somehow seem to do it. Doubtless many a shareholder concerns himself merely with dividends and, not being an engineer, is perhaps not interested in the operating record of his company. Nevertheless, we have always reposed more confidence in those corporations which make a fearless and frank statement of their year's work. They somehow breathe an atmosphere of trust. At least, that is a reaction we had in reading the annual report of the Tonopah Belmont Development Co. Fortunately, it is not an isolated example, for we have mentioned others in these columns from time to time. The itemized operating information given in the statements of this company is so valuable as a record of the cost of mining and milling in Nevada that we have published fairly complete extracts from it.

In these days of rapidly changed prices it is imperative to keep costs as low as possible. One way to judge them is to observe and compare the operating results of other companies working similar deposits. Hence the detailed publication of such data by various mining companies should be of mutual assistance to officials. The free interchange of cost information promotes economies in mining and milling, as it may indicate the greater efficiency of one method of mining or milling over another. It also shows the serious handicap under which an industry may labor when the price of the metal it produces is lower than the cost of producing it.

Mining is not so competitive as manufacturing. The manufacturer has a good reason for concealing his costs. He generally has stern competition to meet. He must develop his own market and may not be protected from sudden competition from an unexpected source by a rival who strives to take it away. On the other hand, the mining company can have little object in withholding cost information. It is participating in a market that is not mainly made by its own efforts, but is the result of world-wide forces of supply of, and demand for, a raw material. The mining company has some competition, but it is not of the same nature as in manufacturing. So why not be more liberal with cost information? It will help company and industry and do away with an element that has always been an impediment to progress—unnecessary secrecy concerning operations and results.

Little Dorrit and the Income Tax

THE CIRCUMLOCUTION OFFICE described by Dickens in "Little Dorrit" is delicious reading, and we recommend it to all executives of mining companies who have struggled with the intricacies of the income-tax returns.

The income-tax law is necessarily complicated, as it deals with the subject of property valuations and invested capital. Valuations of enterprises such as mines cannot be easily determined, as our money unit is a variable quantity which reflects with more or less precision the resultant of economic conditions. Nevertheless, the Internal Revenue Department has struggled with the problem and has succeeded in building up an organization which is functioning fairly well and which appears to have arrived at a procedure which will result in the general clean-up of the situation. The metal valuation section has gone about its work expeditiously; the delays that have aroused irritation have, according to our information, occurred in the audit and review division. Eventually these will be minimized as much as possible, no doubt.

The Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, under recent date ordered the income-tax unit to proceed with a revision of the valuation of the depletion returns of the copper and silver mines in accordance with a memorandum which has been submitted by the unit. Among errors made in valuations which had already been made and approved in settling taxes for 1917 and 1918 were average expected metal prices of silver and copper as of March 1, 1913. The prices that were used were 16¼c. per lb. for copper and 65c. per oz. for silver. The new prices that will be used are the average prices for the ten calendar years prior to 1913 for all metals and minerals upon which adequate quotational records can be obtained. The figures in question approximate 58c. for silver and slightly under 15c. per lb. for copper.

Under this ruling the silver and copper mines will have to recompute their unsatisfied valuations. In every case affected the valuation will be reduced. These are not the only errors that are to be corrected in the returns made by copper mines. Many of the copper-mine valuations were among the first to be made and were made before the valuation section had been properly organized and when there was some doubt as to the proper procedure. As a result, numerous errors crept into the copper valuations. The probable result of the new valuations will be to reduce severely the average unit of depletion as used in settling the income-tax returns for 1919 and subsequent years. The action taken will not affect the depletion on returns made for 1916, 1917, and 1918. The depletion allowed for those years can be distributed tax free to stockholders without change on this account.

Under the regulations of the Treasury Department, once a valuation has been accepted the property in question cannot be revalued. This would appear to raise the question as to the authority of the Commissioner of Internal Revenue to order a revaluation of the silver and copper mines as instances in the foregoing. However, the regulations further provide that valuations may be corrected under certain conditions, of which one is the existence of errors in data used in arriving at a valuation. The income-tax payer, with the permission of the commissioner, has also the privilege of correcting an erroneous valuation. This arrangement plainly is an equitable one.

Depletion of mineral properties is based upon valuation as of a basic date, March 1, 1913, or subsequently for new properties. To this valuation subsequent capital additions may be allowed by the commissioner on proper showing. The value of mineral property includes the value of the mineral deposit, the cost of the development, and the cost of the appurtenances required for its operation and the treatment of its ores or other products. The cost of development can be handled as an addition to the cost of the property, or as an addition to the depreciable assets each year; the recovery of plant cost is provided for by a depreciation rate established at the current rate of the exhaustion of the mineral or on the basis of the estimated useful life of the plant; net income is obtained by subtracting operating expenses, prorated development, depreciation of plant and equipment, and state and local taxes from gross income, resulting from the sales of metal or minerals and other income incident upon operation of the property.

Depletion provides for the return of the capital, represented by the valuation of the mineral and the development included as an addition to the cost of the property, at a fixed rate. It is determined on an annual basis by dividing the unsatisfied value by the number of units of ore, or mineral, represented by this value; the depletion unit thus obtained is multiplied by the number of units of ore or mineral sold within the taxable year. This sum is subtracted from the net income and is the annual return to the stockholder of the capital represented by the value of the mineral deposit and the development included as an addition to the cost of the property. The difference is the amount upon which the income tax is figured.

The revaluation on the basis of lower metal prices will reduce the unsatisfied property value for 1919 and subsequent years. The depletion unit will therefore be smaller and the annual depletion allowed likewise smaller. The net income will be larger and the tax greater. Incidentally, the metal prices represented by the ten-year interval before March 1, 1913, are in terms of an uninflated currency. Current allowances for depletion are in terms of an inflated currency. Thus the miner has his roll sliced at both ends. He has also to pay frequently for the services of an income-tax expert and additional accounting, and must take an occasional trip to Washington to disentangle various difficulties that arise. He must needs be a cheerful person.

Too Much System

NO MATTER how good a thing is, it can be taken or applied in overdoses. As we see it, this is the principal point that is made by the writer of the good-naturedly satirical article "Operations of the Buck Passer Mine" in this issue, that tells in detail how a small mine went into the hands of a receiver as a consquence of too much highfaluting management. . He has in mind no particular property. Possibly he exaggerates somewhat, but most engineers have seen stunts perpetrated that are as ridiculous as those he describes.

Very often successful men who conduct their own business wisely and sensibly go wild when they find themselves in control of a mine. The reason probably

is that a prudent man, who would never think of launching into any other kind of enterprise of which he knew nothing, frequently will invest his money and undertake to direct the policy of a mining enterprise. He will appoint as manager a young man who would have to start as a bookkeeper in any other business if he had stayed at home.

The successful management of a mine, especially a small one, requires a peculiarly practical knowledge of both the technical and business phases of mining. The manager must also be a consummate diplomat in dealing with his employees and with the people living in the locality where the mine is situated. Some small mines are so rich that they are profitable in spite of mismanagement, but where the margin between income and outgo is small, only the most careful and intelligent supervision can keep the balance on the right side of the ledger.

One way to waste money is to use the type of organization and the methods of operation suitable for the Anaconda Copper Mining Co. as a model for a hundred-ton gold-mine enterprise. And yet some inexperienced "easterners"—(we lay it to easterners from force of habit)—try it. We prescribe a perusal of the Buck Passer story as a stimulating tonic—to be taken, perhaps, with a pinch or two of salt.

Relative Efficiency of Crushing Machines

AN INQUIRY from Western Australia comes to us for information as to the status of the investigation on the determination of a method for the estimation of the relative mechanical efficiency of crushing machines, by means of power measurements and a comparison of work done, as measured by the application of Kick's or Rittinger's law to the grading analysis of feed and product. In reply we stated that, although Kick's law had received its quietus several times in recent years, little progress seems to have been made in familiarizing operators with means whereby a comparison of mechanical efficiencies can be made. Lack of finality in the investigations may be due to the fact that efficiency is only one of many factors that affect the decision to purchase crushing equipment. In large-scale operations, an adequate feed opening is essential, and so the Blake type of crusher may be chosen. For finer crushing, a gyratory machine may be preferred because of the character of the product. For still further reduction, a disk crusher may be favored for special reasons; or rolls, because of simplicity. For finer grinding, the ball or rod or tube mill is likely to be considered superior because it is "fool proof" and has a large capacity. Hence the lack of enthusiasm in regard to investigations that consider only the factor of mechanical efficiency per unit of power expended.

Popularizing the Mining Camp

THE HIGH COST of existence in comparative comfort is usually a drawback to living in the average mining camp. Any improvement that will tend to free residents from the exactions of petty tradesmen is to be welcomed, and many mining companies are realizing that a well-managed store is a valuable asset, an aid in lowering labor turnover and minimizing discontent. If such a store be operated by the company, however, without giving employees an insight into profits or losses and methods of control, mistrust is often created, and constant complaint is made in regard to prices and service. To counteract this, a co-operative scheme has been developed on several properties, which has been found to work satisfactorily. The New Cornelia Copper Co., for example, loaned the initial outlay required to equip a trading store at Ajo, Ariz., at a fixed charge of 6 per cent. The business is in the hands of the company; but a co-operative arrangement between it and representatives of employees insures commercial prosperity and mutual satisfaction. All profits above the fixed interest charges are distributed among customers who have been in the employ of the company for at least four months. The store was opened in 1917, since when over $153,000 has been distributed as dividends. Such a plan cheapens the cost of living and promotes satisfaction among employees; but capable management is essential to success in this as in most other activities.

Muscovite and Muscovy

WHITE MICA was called muscovite by Dana, from *vitrum muscovitum*, or Muscovy-glass, by which name the mineral had long been known popularly. Muscovy, of course, is the old name for the ancient central part of Russia—the Grand Duchy of Muscovy, of which Moscow was the capital. As to the uses of Muscovy-glass, here is a quaint versified description from a letter written to "Spencer by Master George Turberuile out of Moscovia" in 1568. Master Turberuile was secretary to Master Thomas Randolph, Ambassador of Her Majesty (Elizabeth) to the Grand Duke:

They have no English glasse, of slices of a rocke,
Hight Sluda, they their windows make, that English glasse doth mocke.
They cut it very thinne, and sawe it with a thred,
In pretie order like to panes, to serve their present neede;
No other glasse good faith, doth giue a better light,
And sure the rocke is nothing rich, the cost is very slight.

To all of which it may be added that the people of Muscovy still persist in seeing things in a different light from what is the usage in England.

No Wonder the British Think This a Rich Country

THE MANUFACTURE of arsenic at present prices is generally considered to be a profitable undertaking, but it takes the Americans to make the most of the business. According to the London *Mining Journal*, the Jardine Mining Co., in Montana, has made its first shipment of arsenic from its new plant and "it is stated that the price agreed on was 14½c. a lb. or $290 a ton f.o.b. Bound Brook, New Jersey, the total sale amounting to $21,750. . . . The net receipts by the Jardine company, after paying freight on the arsenic and packages, will be approximately $20,400. It is stated that this sale will take care of the construction of the arsenic plant, the roasting of the concentrates, the refining of the crude arsenic, its barreling and delivery at the shipping point, and will leave in the vicinity of $50,000 net profit."

That's the way we do things in this country.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Another Lead Blast-Furnace Crucible Resists Confinement When Not in Use

THE EDITOR:

Sir—In your issue of March 24, 1923, appeared an article entitled "A Metallurgical Phenomenon," by D. W. Jessup, in which was described the cracking of a blast-furnace crucible after a campaign. I am enclosing two views showing the same phenomenon at a blast furnace at the Great Falls Reduction Department of the Anaconda Copper Mining Co.

This furnace was used for years as a copper blast furnace, and after standing idle for two or three years it was slightly changed and used as a lead blast furnace. At the time of its conversion to a lead furnace, no sign of cracking of the crucible was apparent, but after a year and a half's campaign as a lead furnace, it was shut down and allowed to stand idle under the same weathering conditions as had existed during the period between its use as a copper furnace and the starting as a lead furnace. A few months after being shut down, after its use as a lead furnace, it was noticed that the castings around the crucible were pulling apart in the front, just below the tap hole. The first expansion took place at the bottom of the castings and gradually extended to the top of the castings, finally shearing all four 2¼-in. diameter bolts holding these castings together and leaving an opening approximately 16 in. wide. It will be noticed in Fig. 1 that the first two bolts sheared next to the head of the bolt, and the upper two bolts sheared at the threaded end of the bolt.

Fig. 1—Sheared bolts after expansion of crucible

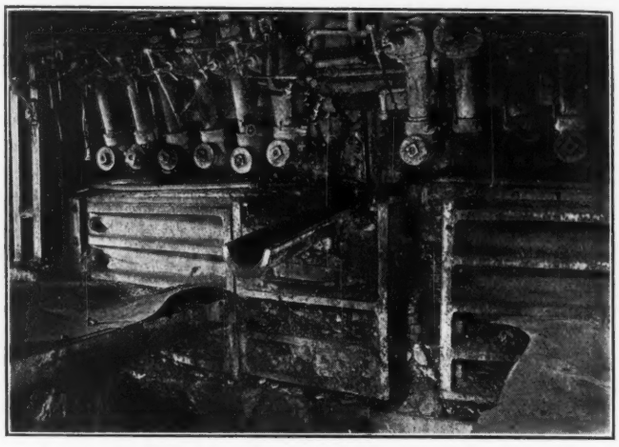


Fig. 2—Front view of crucible, showing effects of expansion

Another evidence of the pressure exerted on the crucible is a considerable deflection of the building column shown to the left of Fig. 2, and also the buckling of the platform at the left side of this view. This crucible was built of brick alone, a cast-iron bedplate being placed under the brick. Since these views were taken, this crucible has been torn down and it was found that practically all of the brick in the crucible were heavily impregnated with lead and a considerable proportion of these brick show signs of oxidation of the lead to litharge. Evidently all of the expansion was due to oxidation of lead, as the copper matte remaining in the crucible after the campaign as a copper furnace had not caused any trouble prior to starting as a lead furnace.

This information is sent to you merely as a confirmation of the data contained in the article by Mr. Jessup.

Great Falls, Mont. R. B. CAPLES.

A Prospector's Fight

The following letter was not sent in for publication, but it has so much real human interest that we are printing it, omitting the name of the sender:

THE EDITOR:

Sir—Unfortunately I am a late recruit in the mining game, and did not know of your rule or condition to a subscription securing your practically indispensable journal, regarding the necessity of defining my place in the game of mining. For further information than is herein contained, allow me to refer you to an article entitled "The Thoughts of a Prospector," a portion of which was published in your magazine last fall. This information, I will supplement with the further facts

that two years ago I arrived at Jerome, Arizona, in the spring time and was speedily located by a still more needy individual, as a would-be ("greenhorn") prospector who had $750 cash. I was taken into the hills, and shown around. I dug every place I was told to. Dry weather came on, and one of the prospect holes held water like a jug, and two cows drowned in it. The first gold I saw was from a quartz vein I traced up to where another seemed to cross it. I located this by trenching. My friend found that this was patented ground. However, we were good friends, and he would show me ground adjoining his own that had just been deserted, the man having taken up a farm 12 miles away. My friend had sold a third interest in this claim for $300 fourteen years ago. Several thousand dollars had been spent in improvements, and they failed to find anything but small pockets, principally high-colored quartz. There was some black stuff resembling bitumen on this, and this looked "good" to me. I was shown a coloration of the ground about fifty feet from where a considerable hole had been sunk, close to where the croppings that this hole was on had "pinched" out; so I went to work. Three feet below the surface, I came upon an apex of where this vein came in again. It would not pan a color. I finished the hole to ten feet deep, and as I was putting the finishing touches upon it, my friend looking on, he picked up a piece and said looked like it had gold in it. When panned he judged it would assay about $200. I sent a sample to an assayer, which returned $78. We went to town, and he talked me and a man who owned a second-hand milling outfit into a sale, on time, so I came back with the mill. He also borrowed $50 and I gave him a $40 grub supply. I then told him I was broke, and he had no further use for me.

However, I had a $100 bond. This I sold, built me a small shack and got through the winter on the proceeds. The next spring the man who was supposed to have deserted the ground I was on, came around and dug up some tools he had buried when he had done his only assessment work upon the place some ten years before. He told me to keep it if I wanted to, as he regarded it as worthless and had only taken it for the machinery and buildings, which had been removed.

My ore at this time assayed only $4 and "wouldn't pan."

My lode has faulted off from elsewhere (unknown) with the strike of the rock about 45 deg. pitch. I am going down on the end of it; am about forty feet deep, and have five feet in width which will average between $5 and $25 in free gold. It has a patronite vanadium content, which, being migratory, has run around from an overflow at the end, and settled in spots.

I am waiting for rain to give me water to make my first mill run with (the mill is advertised at fifteen tons).

PROSPECTOR.

A Silver Program

THE EDITOR:

Sir—"The United States of America shall and will buy five hundred million ounces of fine silver in the open market at a price of not more than one dollar per ounce, from citizens of the United States of America and of silver produced in the United States of America or its possessions.

"The proper officer of the United States of America shall and will issue temporary certificates for the purchase of this silver.

"Be it hereby enacted, and such acts of Congress in conflict hereto amended, That the Treasury Department shall not issue, nor permit to be issued, any bill, note or legal tender of a denomination of less than twenty dollars except Treasury Certificates for coin or bullion held in the custody of the Treasury of the United States of America."

The foregoing is offered as a basis for laws to be enacted by Congress to supply the needs of the country. The demand and need of the country for currency of small denominations has been such that the United States has issued a large amount of one dollar Treasury Notes. The Federal Reserve Banks have issued a large amount of notes of one dollar denomination. The foregoing suggested legislation is not intended, in any way, to conflict with the Federal Reserve Banking system nor to restrict the credit of the United States of America, but there is a need for currency of small denominations, as has been shown by its issue.

This is not a plea for free silver, for that question has been settled.

The benefits to be derived are manifold—the increase of the foreign credit of the United States by the increase of its stock of bullion, the profit directly gained by seigniorage—the increased value of taxable property and taxable income.

JOHN F. LYON.

Albany, N. Y.

The Human Equation in Grinding Ore

THE EDITOR:

Sir—Mill superintendents are well aware that better results are obtained on the whole during the day shift than during the night shift. This difference is due sometimes to modification in the method of operation during the night shift, but, as a rule, full capacity is aimed at and it is generally conceded that the difference in operation is due to the individual operator. There is evidence, also, that the effect of the human equation is felt right on up the line, even so far as the manager himself. For instance, when the direction or supervision of a plant changes hands, it is often found that the mill as a whole will change in over-all efficiency, even when no change in the equipment has been made. It sometimes happens that the superintendent is supplied with a mill of different design or type than the one he favors. Conscientious as he may be in his endeavor to produce the best results, he is unable to obtain as satisfactory operation as he should, because his heart is not in the work.

The human equation is always recognized by those who handle men successfully. Ways and means are employed to take care of the variation in ability and temperament that exists. For example, in large mills where there are a number of grinding sections, competition between the operating crews is encouraged where conditions will permit. Bonuses or prizes are awarded to the crew or operator producing the best results.

With these factors in mind, consider how difficult it is to compare the grinding done in one plant with that in another. Coupling this with the other factors I mentioned previously, it becomes obvious why reliable comparisons and accurate deductions are extremely difficult and wellnigh impossible to make. The elimination of the variables due to the human equation in milling, as well as in other work, will assist greatly in overcoming the difficulty of devising means to predict results.

New York City. HARLOWE HARDINGE.

Metallurgical Engineers of Note

ARTHUR CROWFOOT

THOUGH a large number of Englishmen have elected to follow the mining industry, not a great many have come to this country. They have chiefly emigrated to the British possessions—South Africa, Australia, India, and Canada—and have seemingly preferred precious-metal mining. Had Arthur Crowfoot been a graduate of the Royal School of Mines, possibly the copper industry would have had to get along without him, but, as it was, he was educated at Beceles College, in Suffolk County, England, and apparently had little thought of mining. In February, 1894, at the age of twenty-one, he came to America to visit friends in Denver, and afterward decided to try his hand at ranching, which he followed until November, 1895. Then he felt the call of the copper-mining industry and went to Great Falls, Mont., entering the employ of the Boston & Montana Consolidated Copper & Silver Mining Co., which later became the Boston & Montana reduction department of the Anaconda Copper Mining Co. Here, Crowfoot got his start as ore-bin man in the concentrating division, later being promoted to jig and table man, general repair man, and sampler in a special concentrator investigation. In fact, during the nineteen-year period that he stayed at Great Falls—1896-1914—he got wide experience, being employed as concentrator operator, sample-mill foreman, slime-plant foreman, blast-furnace feeder, tapper, and foreman; testing engineer covering concentrator, electrolytic and furnace refining and smelter investigations; and general smelter foreman. While at Great Falls, Mr. Crowfoot's special investigational work included smoke and fume problems, smelter gas measurement, precipitation of arsenic, pyritic smelting in blast furnaces, and application of producer-gas firing to reverberatory furnaces, the development of high-tonnage roasters, basic converting, fine grinding in ore concentration, concentrator design, the treatment of concentrator slime on buddles (prior to the advent of flotation), and the classification of concentrator pulps. In August, 1914, with the closing down of the Boston & Montana reduction plant, he was transferred to Anaconda, and in December accepted an offer to take charge of the Arizona Copper Company's concentrator at Morenci. A few months later, he was also given charge of the Clifton concentrating plant, a few miles distant. In 1916, Mr. Crowfoot was called on to prepare plans for the reconstruction of the Clifton concentrator for a capacity of 500 tons a day, and to enlarge the Morenci plant from a capacity of 3,000 tons daily to 4,000 tons, flotation being adopted at the same time. This work was completed in 1917. In 1918 he designed and constructed a 400-ton pilot mill for treating the low-grade sulphide ore in the Clay mine, at Morenci, this plant being operated for two years. The flow sheet of the large Morenci mill was also further developed, the main features being tabling at 6 mesh, flotation at 48 mesh and regrinding of the flotation tailing, followed by a final flotation treatment. Large pneumatic cells with a capacity of three tons per square foot cell area per twenty-four hours have been developed. During the latter part of 1922, the Arizona Copper Co. was taken over by the Phelps Dodge Corporation, Mr. Crowfoot being retained in charge of concentrator operation. Plans were made for increasing the capacity of the Morenci plant to 5,000 tons, which is now being done. Mr. Crowfoot was for a time slated to take charge of the new concentrator treating the Sacramento Hill ores at Warren, but has been retained at Morenci to supervise the enlargement and reconstruction of the plant with which he is so familiar. In addition to carrying on much investigational work in concentration in Arizona, he has also made a study of leaching and carried on special work in the extraction of copper from old tailing material. In these experiments both sulphuric acid and sulphur dioxide were used as solvents.

ARTHUR CROWFOOT

While at Great Falls, Mr. Crowfoot was married to Ella May Richardson, and they now have five children, three being girls. Even in the wilds of Arizona they play golf, and Arthur Crowfoot is a member of the Greenlee County Golf Club. He is also on the membership rolls of the Morenci Club, the A.I.M.E., the A.A.E., and the American Mining Congress.

The Marketing of Lead

New York and St. Louis Most Important American Basing Points—Four Grades Sold—Exceptionally Well Diversified Uses of Metal—Foreign Market Has an Important Bearing on Domestic Prices

By Irwin H. Cornell
Vice-president and Sales Manager, St. Joseph Lead Co.

Irwin H. Cornell

In the United States pig lead is usually sold by the mining or smelting companies directly to the consumer. The smallest quantity sold is a minimum car. Before the World War the standard lot was considered 25 tons, and monthly sales were often reported as so many cars of lead. As the capacity of the standard box car increased, there was an effort on the part of some of the producers to increase the standard minimum, and in 1913 many sales of 30 tons were effected. When the United States entered the war and transportation became difficult, the government, through the Railroad Board, endeavored to increase the loading of box cars. With the co-operation of the lead producers, shipments were increased to a minimum of 33 tons. The benefits of loading box cars 10 per cent above the marked capacity were evident, and the practice has been continued since the war in the majority of shipments. Single car sales of lead today are usually made in lots of 33, 45, or 55 to 58 tons (2,000 lb.).

In every large city in the United States there are metal houses that make a practice of retailing lead This is sometimes done by makers of lead pipe and by secondary smelters, and often by houses that carry a general line of non-ferrous metals and whose principal business is that of retailing metals. These houses also care for the local water companies' carload business and often sell to the cities and towns. The practice of the smelting companies of making prices for acceptance before 5 p.m. on the day that the quotation is made prevents them from submitting sealed bids to cities and to contractors bidding on water pipe lines.

Sales of wholesale lots of pig lead at fixed prices are usually made by telephone or telegraph, on account of the changeable market. The general practice is to offer lead about 2 p.m. for wire acceptance on the same day, and when the market is active, offers are often made for acceptance within the hour. One seldom hears of offers "subject to prior sale," as such an offer to an out-of-town buyer has not much value.

In St. Louis, lead is sometimes offered "subject to no change in the official price," referring to the price on which the American Smelting & Refining Co. bases its ore purchases and sales of refined lead.

Contracts or memoranda of sales are written by the vendor, and usually name the brand or grade, the position, or the month during which shipment is to be made, and the terms, and conclude with a "force majeure" clause. When lead is offered the position is always mentioned, for instance "Spot," meaning lead already in city of delivery, "Prompt," for shipment within three or four days, or "January" lead, meaning for shipment from refinery during the month of January. On a falling market the position is usually rigidly enforced, and if January lead is not shipped until February, the vendee sometimes insists that it shall be billed at the February and not the January price. Delayed shipments may force the vendee to buy "Spot" lead at a premium to keep his factory in operation. The arrival of the lead is always at the buyer's risk; if the metal leaves the refinery on time it is a good delivery.

In cases of loss in transit the vendor usually allows the vendee the value of the missing metal and in turn collects from the transportation company. Retailers of lead usually make delivered prices and include the trucking charge.

Prices are quoted by the producers on the basis of 100 lb.—i.e., 7.20 Pittsburgh means $7.20 per 100 lb. delivered Pittsburgh. On some occasions prices are quoted in fractions, as 7⅜, but usually $7.37½. The normal variation in price is 2½c., and one seldom hears of a price of $7.36; it is either $7.35 or $7.37½.

The standard terms of payment are cash on arrival. This usually means draft attached to documents payable on arrival of car at destination. As a matter of convenience, however, every large seller has a list of customers in good standing to whom lead is consigned direct. Even in these cases the lead is supposed to be paid for on arrival, and a buyer usually is removed from the list if he fails to remit as soon as the car arrives. Arrival dates are checked up through the railroads.

Routing is usually left to the vendor, with the exception of the delivering line. Tracing is done by both vendor and vendee. Shipping, routing, and tracing are services which the vendor has to offer, and he would rather in every case give the preference to some regular consumer than to a dealer who buys for some unknown consumer.

The producing sellers and the consumers often work in close harmony that is valuable to both. They exchange market gossip, give advice, and compare statistics concerning production and consumption.

Sales Made Principally in New York

Almost all the important sellers maintain offices in New York City. Most of the large buyers are located there. If the purchasing departments of the large consumers are out of town, prices are often obtained through the New York sales departments of these companies. Some few out-of-town buyers use New York brokers to gather prices and market information. The comparatively small amount of business done by these brokers is on a commission of one-half of 1 per cent.

The following is a list of the important companies that sell pig lead in the United States:

American Smelting & Refining Co., New York.
St. Joseph Lead Co., New York.
United States Smelting, Refining & Mining Co., New York.
United Metals Selling Co., New York.
American Zinc, Lead & Smelting Co., New York.
Eagle-Picher Lead Co., New York and Cincinnati, Ohio.
Guggenheim Brothers, New York.
Desloge Consolidated Lead Co., St. Louis.
Bunker Hill Smelter, Kellogg.
(Sells its own output for delivery west of the ninety-second meridian.)
American Metal Co., New York.
Pennsylvania Smelting Co., Carnegie, Pa.
Balbach Metals Corporation, Newark, N. J.
John Wahl Commission Co., St. Louis.
(This is not a producing company, but sells a considerable portion of the output of the Desloge Consolidated Mining Co.)

During the last ten years the trend toward buying in New York has been very noticeable, and it is now customary for important consumers to make trips to New York once or twice a month to interview the sellers of lead and of other important commodities which they buy.

Some of the sales agents of the producers make trips once or twice a year to see the trade, but, being momentarily out of touch with New York, their business usually has to do with the renewal of average-priced contracts, or is for the purpose of meeting new buyers or renewing old friendships.

During the ten-year period ending in 1921, the world's production of pig lead has been estimated at 11,828,000 net tons, and the United States production, 4,988,000 net tons, 42 per cent of the world's production being produced from mines in this country. Reliable figures of consumption are not available, but it is fair to assume that more lead was consumed by the United States during this period than was produced from the mines of the country.

Exports of domestic lead have been insignificant except during certain periods just before and during the World War. Foreign lead has at times been imported in large quantities, particularly in 1920 and the second half of 1922, and in 1923.

The peace-time per-capita use of pig lead in the United States is enormous compared to that of the rest of the world, and is apparently on the increase.

The peak of the American production occurred in 1916, during which year 592,000 tons was produced from American mines. In 1917 582,000 tons was produced, and for the five years ending December, 1922, the average production was 459,000 tons. Under the stimulus of the present price (1923) the production in 1923 will exceed 500,000 tons, but it is doubtful if the record year of 1916 will ever be exceeded from the present known orebodies in the United States.

The comparatively high average price prevailing for the last seven years has increased the production of secondary lead, and today the return of scrap lead from the battery and cable industries has reached a large figure.

Consumers Found East of Mississippi

The consumption of pig lead is principally in the northeastern portion of the United States. It would be included in a line drawn around the cities of St. Louis, Louisville, Cincinnati, Baltimore, Philadelphia, New York, Boston, Buffalo, Detroit, and Chicago. There is a comparatively small consumption on the Pacific Coast. Of 500,000 tons of pig lead produced in the United States annually, 450,000 tons are sold for delivery on or east of the Mississippi River.

The major consuming centers are New York, Chicago, Philadelphia, and St. Louis. The minor centers are Baltimore, Boston, Buffalo, Cleveland, Cincinnati, Detroit, and Pittsburgh, and, on the Pacific Coast, San Francisco and Seattle. Lead reaches these eastern points through three gateways—St. Louis, Chicago, and New York.

The two major markets are New York and St. Louis. The Chicago market is dependent upon the St. Louis and the New York markets, and Philadelphia upon the New York market alone. In the minor centers, there are minor markets determined by the freight rates from the three gateways. Through the New York gateway lead enters from Mexico, from San Francisco by water, from Utah and Idaho via Pacific Coast ports and the Panama Canal, and also large tonnages since the war from Spain and Mexico.

Through the St. Louis gateway, the Missouri lead reaches the eastern markets, and through Chicago is shipped the lead originating in the silver-lead mines of Idaho, Utah, and Colorado, which is not destined for factories actually situated at tidewater.

The two major markets of New York and St. Louis are the only American markets regularly quoted by trade papers and journals. At least one-half of the lead produced in the United States is sold at a price based on some average price; the important basing prices being the New York and St. Louis prices of *Engineering and Mining Journal-Press* and the American Smelting & Refining Co.'s "official" average price. It has been the custom of the American Smelting & Refining Co. for many years to issue quotations covering the New York lead market. This quotation is termed "official" contract price and is subject to change, depending upon market conditions. It is used in the settlement of many contracts which the Smelting Company has with buyers and sellers of lead. Prompt notification of a change in the official price is made to interested parties and the public. Quotations for lead are practically all made f.o.b. delivery points, and, when shipments are made, the freight is prepaid or allowed.

The delivered prices for lead sold at points other than New York and St. Louis on average-priced contracts are based on differentials above or below the basing price of the *Journal-Press* or Smelting company. A surprising tonnage of lead products are sold based on the average price of lead. During recent years contracts for lead oxides for consumption by storage-battery manufacturers have been made at a fixed differential above the average monthly price of lead, and in some cases the batteries themselves are sold at a sliding scale depending on the average price of the metal lead.

Lead-incased cable is marketed by some producers at prices depending on the monthly prices of lead and copper, and, in fact, the average price seems to be entering more and more into the pricing of metals and metal products. Undoubtedly, this practice has grown faster since the war, during which lead was sold for government account by producers to consumers at the average monthly price of the *Engineering and Mining Journal*.

Diversified Use of Lead

Lead products can be divided into two classes. First, the products in which the lead is combined with other elements and the change is a chemical one. Second. the products in which the lead retains its metallic characteristics, in which case the change is physical.

In the order of their importance the products in the first class are:

White lead or lead carbonate, $PbHCO_3$.

Red lead or lead oxide, Pb_3O_4.

Litharge or lead oxide, PbO.

Sublimed white lead or lead sulphate mixed with lead oxide, $PbSO_4 + PbO$.

In addition there are other products of lead made in smaller quantities as follows:

Lead acetate,	Lead arsenate,
Lead chromate,	Lead nitrate,
Lead lactate,	Lead linoleate,
Lead oleate,	Lead peroxide (brown).
Lead resinate,	

White lead in oil, which is lead carbonate ground in linseed oil, is used almost exclusively as paint. Since the World War the annual consumption has averaged well over 100,000 tons per annum, and in 1921 and 1922 it approached closely to 150,000 tons. Dry white lead is a product that is used in the paint trade; the tonnage consumed per annum has been about 30,000 tons during the last few years. Lead oxides are used in many trades, the storage-battery industry taking the largest quantity, with the paint trade the second in importance. Oxides are also used in the manufacture of rubber, glass, and oil. Sublimed white lead is used as a paint pigment, and lead arsenate as an insecticide.

Blue-lead products are battery plates, cable covering, lead pipe, traps and bends, sheet lead, babbitt, solder, shot and bullets, foil, caulking lead, type metals, counter-weights, brass, terne mixtures, seals, lead castings, lead-lined pipe, and various shapes of lead extruded in presses, such as came lead, ribbon lead, and lead wire. Lead wool is used often to caulk bell and spigot pipe.

The consumption of almost all lead products is on the increase and seems to gain faster than the gain in population of the country. This is particularly true of storage-battery consumption. Batteries are used for starting and lighting automobiles, for lighting railroad equipment, farm and country houses, to furnish power for submarines, power plants, mine locomotives, industrial trucks, radio sending and receiving stations, and for pleasure cars. This industry has been of great advantage to the primary smelters who treat ores containing antimony and from time to time are obliged to convert their antimonial lead slags into antimonial lead. This product is usually refined and sold on specifications by the secondary smelters direct to the storage-battery companies. Antimonial lead, as produced by the primary smelters, contains from 15 to 20 per cent of antimony, from one-quarter of 1 per cent to 1 per cent of copper, and approximately the same amount of arsenic. The battery metal contains about 3 to 6 per cent of antimony and a small fraction of 1 per cent of copper and arsenic. Probably 25 to 35 per cent of the lead consumed by the battery industry is bought in the form of battery metal—i.e., antimonial lead containing a small percentage of antimony.

There are four grades of pig lead sold in the United States, corroding lead, chemical lead, desilverized or common lead, and soft Missouri lead.

Corroding lead is double refined lead, and is made by submitting desilverized, chemical, or soft Missouri lead to a second refining process. It usually commands a premium of from two to three dollars per ton.

Chemical lead is lead produced from southeast Missouri ores; is free from bismuth, and contains small quantities of silver and copper. Desilverized lead is made from the argentiferous lead ores mined in the Rocky Mountain states. Some of these ores contain bismuth and some do not. The bullion is desilverized primarily to recover the silver and gold values. If the low-bismuth ores are treated separately, corroding lead can be produced by a single refining process.

Soft Missouri lead is a trade name given to lead made from ores mined in the Joplin (Tri-State) district. This lead contains somewhat less copper and silver than chemical lead. There is a grade of lead refined by the Betts electrolytic process. It is usually sold, however, as desilverized or corroding lead, depending on its purity.

To give a fair idea of the chemical analyses of the various grades of lead, the specifications of the American Society for Testing Materials are given below, with the method of sampling recommended by that society.

The tentative specifications (serial designations: B20-22T) for primary or virgin lead issued in 1919 and revised in 1920 and 1922, provide that the lead be made from ore or similar raw material by direct processes of reduction and refining, and not produced from reworked metal. Under these specifications virgin pig lead is considered in three grades as follows:

Corroding Lead (Grade I)

	Chemical Composition, Maximum Per Cent Allowable
Silver	0.0015
Copper	0.0015
Copper and silver together	0.0025
Arsenic	0.0015
Antimony and tin together	0.0095
Zinc	0.0015
Iron	0.002
Bismuth	0.05
Lead (by difference)	99.9330

Chemical Lead (Grade II)

	Chemical Composition, (a) Per Cent
Copper	0.04-0.08
Bismuth	Less than 0.005
Silver	0.005-0.015

(a) This composition represents present requirements in the United States.

Common Lead (Grade III)

	Chemical Composition, Maximum Per Cent Allowable
1 Desilverized Lead:	
Silver	0.002
Copper	0.0025
Arsenic, antimony, and tin together	0.015
Bismuth	0.25
Iron	0.002
Zinc	0.002
Lead (by difference)	99.7265
2 Soft Missouri Lead:	
Silver	0.002
Copper	0.04
Arsenic, antimony, and tin together	0.015
Bismuth	0.005
Iron	0.005
Zinc	0.002
Lead (by difference)	99.931

The specifications of the A.S.T.M. state that in sampling, a carload or less shall be considered a lot or unit. One pig shall be taken to represent each ton of lead in the lot. The pigs thus taken shall be sampled by sawing completely through; by punching completely through (if equipment permits) or punching halfway through from two opposite sides; by drilling at least halfway through. If the sample is taken by sawing, the sawdust from all pigs shall be thoroughly mixed and quartered and the sample for analysis drawn from the mixed material. If the sample is taken by punching or drilling, the holes shall be spaced along a diagonal line from one corner of the pig to the other. If punchings are taken they may be carefully melted in a clean graphite cru-

cible, and either granulated . . . or cast into thin slabs which shall be sawed completely through in several places. If drillings are taken, they may be clipped and mixed and the sample for analysis drawn from the mixed material or they may be melted as in the case of punchings.

The specifications go on to say that claims to be considered shall be made in writing within thirty days of receipt of the material at the purchaser's plant, and the result of the purchaser's test shall be given. The seller shall be given one week from date of receipt of such claim to investigate his records, and then shall agree either to satisfy the claim or to the submission of samples to an umpire. No claim shall be considered unless the sample pigs can be shown to the seller's representative. On questions of purity a sample shall be drawn by representatives of both parties as described under sampling. The properly mixed and quartered sample shall be separated into three parts, each of which shall be placed in a sealed package, one for each party and one for an umpire, if necessary. Each party shall make an analysis, and if the results do not establish or dismiss the claim to the satisfaction of both parties, the third sample shall be submitted to a mutually agreeable umpire, who shall determine the question of quality and whose determination shall be final.

The expense of the seller's representative and of the umpire shall be paid by the loser, or divided in proportion to the concessions made in case of compromise. In case of rejection being established, damages shall be limited to the payment of freight both ways by the seller for substitution of an equivalent weight of lead meeting these specifications.

Lead Quality and Prices

The primary use of corroding lead is the manufacture of white lead. This product must be a pure white and therefore requires the purest grade of pig lead. A very small amount of silver will cause a pink shade in white lead. Bismuth is objectionable on account of the grayish tint it produces, and because it interferes with the grinding to a certain extent. Copper gives a green tint and iron a red tint.

The battery industry uses almost every grade of lead. Of late years a large amount of corroding lead has been used in manufacturing battery oxides. Chemical lead is used by the battery makers for Planté plates, container linings, straps, and in some cases to cut down battery metal from a 6 per cent antimonial content to a lower percentage before it is cast into battery plates. Cable makers use large quantities of chemical lead and also desilverized lead, the practice varying in the different factories.

Solder and shot makers prefer desilverized lead. Sheet lead for the chemical industry is usually made from chemical lead, and traps and bends are largely made from chemical lead. All grades are used in the manufacture of pipe, foil, babbitt, and type metals.

Pig lead is cast in pigs or bars weighing from 80 to 100 lb. Some smelters cast caulking lead in small bars weighing two or three pounds per bar. This product is sold at a higher price and is not classified as pig lead.

For the greater part of the time since the end of the World War the price of lead has been a world price, the London prices having a great influence on the New York prices, and vice versa. For instance, the cost of transporting lead from Mexico to New York is about the same as from Mexico to London, and ocean freights from Spain to London or to New York are about the same. A large tonnage of Mexican ore is smelted and refined in the United States. As this lead is produced in America, it is more economical to sell it in New York than to ship it to England or to the Continent, providing the prices after allowing for the duty are in balance. The first foreign lead therefore to be consumed in the United States would be that made in America from Canadian or Mexican ores and bullion. The comparatively high prices of lead during 1920 and 1923 were due to the fact that America and Europe were competing for the Mexican production. At times during this period, lead sold on the London Metal Exchange was repurchased at a lower price, and the Mexican lead thus released was sold duty paid in New York and Philadelphia. Arbitrage business of this kind kept the two prices in balance. In some cases lead has been shipped from Australia in wool cargoes originally destined for London, and while it was afloat the relation between the London and New York prices changed sufficiently to make it advantageous to unload the lead in New York for consumption in that port.

For the last two years Spanish lead has been marketed in New York through representatives or agents of a large French company.

Under normal conditions the price of lead in St. Louis varies from $2 to $5 per ton below the New York price. When foreign lead is imported into the United States through North Atlantic ports, it has a tendency to depress the New York market price and may bring it to a parity with St. Louis and occasionally below it. The St. Louis market price varies more than the New York price. On a rising market it usually advances before the New York price, and is the first to react when prices weaken.

Although the American production is much greater than that of any other producing country, the consumption in the United States has been so large that supplies have been drawn from the great lead-producing countries of Mexico, Spain, and Australia. All indications point to a continued increase in the consumption of pig lead by the paint and electrical industries of the United States.

Production of American Lead Refineries 1917-1922 (a)

In Tons of 2,000 Lb.

Domestic	1917	1918	1919	1920	1921	1922
Desilverized	319,015	284,733	226,085	236,912	202,508	210,039
Antimonial	16,265	18,658	14,864	8,992	5,419	6,265
S. E. Missouri	205,861	189,207	158,182	206,836	142,804	203,327
S. W. Missouri	40,575	63,635	55,790	29,004	56,155	63,666
Totals	581,716	556,233	454,921	481,744	406,896	483,297
Foreign						
Desilverized	50,962	98,596	61,380	51,700	47,697	66,781
Antimonial	2,991	2,083	1,547	2,197	2,361	1,126
Totals	53,953	100,679	62,927	53,897	50,058	67,907
Grand totals	635,669	656,912	517,848	535,641	456,954	551,204
Secondary lead(*b*)	93,500	97,100	122,100	124,650	106,340	159,560

(*a*) Including lead derived from scrap and junk by primary smelters.
(*b*) U. S. Geological Survey.

Production of Radium in Cornwall Resumed

The commercial production of radium at the pithead in England began recently with the completion of an extraction plant at the South Terras mine, in Cornwall, says *Commerce Reports*. The capacity of the plant is reported as 300 to 400 mg. a month. To reduce the bulk of the ore, and lessen the quantity of expensive chemicals necessary in the process, a new concentration plant is being built.

The New Magnetic Concentrating Mill at the Richard Iron Mine, New Jersey—II*

Specially Designed Wet-belt Magnetic Separator Proves Much Superior to Dry Types Formerly Used—Voltage Regulator on Magnets a Feature—Mill Costs Average 27c. per Ton, Excluding Important Credits for Byproducts

BY H. M. ROCHE

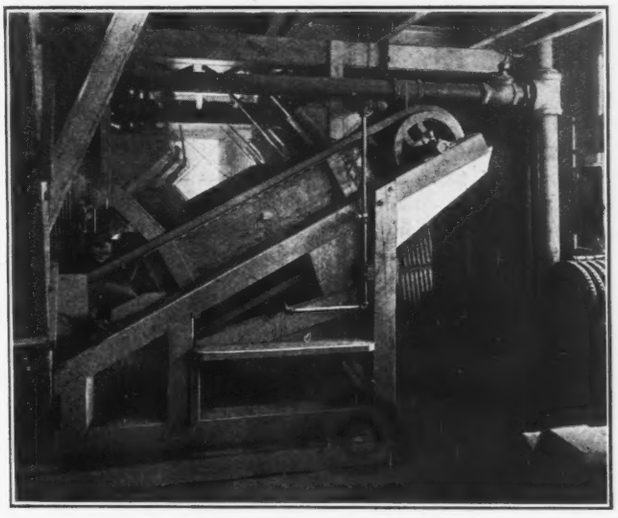
HERETOFORE, in the magnetic concentration of New Jersey iron ores, only two types of magnetic separators have been used. For coarse ore, plus 8 mesh, a Ball-Norton type dry-drum separator has been used, and so far no other machine has been developed that can take its place. For fine ore, minus 8 mesh, a Ball-Norton type dry-belt separator has been used, but this machine has not been efficient, except perhaps on dry fine crystalline ores such as occur in the northern part of New York. To effect magnetic separation on most fine ores with dry-belt machines, the ores have to be dried and fed to machines in a very thin stream. As the moisture in the crude ore varies from 6 to 20 per cent, it is almost impossible to obtain a feed that has a uniform moisture content, and if the material is not bone dry, good separation cannot be made. Another reason for the failure of these machines is that small magnetic pieces of ore attract one another and, consequently, entrain considerable non-magnetic material, which is carried over into the concentrate.

The principles of magnetic concentration are admirably explained in Bulletin No. 9 of the University of Minnesota, by Edward W. Davis. The most efficient way to separate fine ores is by wet magnetic separation. In passing over wet machines the particles of ore are not only agitated by the alternating pole or by mechanical means, sometimes assisted by the high specific gravity of iron ore, but are also agitated and washed by strong water currents.

Although a great many patents have been taken out covering wet magnetic separators, so far only two types, exclusive of the Roche wet-belt machine, have been successfully used. One is the Grondal drum separator. The feed to this drum is mixed with water and fed to the drum, separation and agitation is effected by magnets with alternating poles, and additional agitation is secured by strong water currents. The second machine, for treatment of very fine ores, is the magnetic log washer which was designed at the Minnesota School of Mines Experiment Station. This machine is successful in treating minus 48-mesh material, but is not recommended for a coarse or unclassified feed. Use of the alternating pole principle is not taken advantage of in this machine, agitation of ore while passing over the magnets being secured by means of screw or ribbon conveyors. The Grondal machine has not proved satisfactory in some respects and it is generally necessary to use two of these drums in tandem to effect efficient separation where one machine should do the work. The magnetic log washer is only suitable for ores minus 48 mesh, and the screws wear out rapidly.

To avoid high installation, operation, and repair cost of wet magnetic drums and log washers, together with their low capacities; to avoid the difficulties of dry separation of fine ores and costly classification of fine feed, I have designed a new wet-belt magnetic separator which treats feed ranging from minus 8 mesh to plus 300 mesh, providing the particles of iron are sufficiently unlocked to make the grade of concentrate and tailing desired. However, the wet-belt machine will treat successfully ores of any fineness.

Ore, in passing from magnet to magnet on this machine, is turned over and over while being washed with water. Agitation by the alternating pole principle and strong wash water currents prevents non-magnetic material from being entrained with the concentrate, and as a result the machine produces a higher grade of concentrate and lower-grade tailing than the dry-belt machine. In sluicing feed through launders to these machines the particles of iron naturally settle to the bottom of the launders, on account of their high specific gravity, and in discharging from the launders to the machines, the iron, being underneath, strikes the magnets before the lighter non-magnetic material, thus securing direct contact of iron particles with the magnets before separation and agitation begins. The wet-belt machine consists of a set of magnets underneath an inclined vanner or flanged belt. The machine is set at an angle of from 10 to 80 deg., the belt moving up the incline toward the head wheel, and feed mixed with water being fed to the lower magnets. The magnets are of the alternating pole type, and twenty magnets, spaced 3-in. centers, are used in each machine. Feed strikes the magnets nearest the foot wheel and the magnetic iron material clings to the belt and is carried up over the upper magnets and head wheel while the tailing is



End view of Roche type wet-belt magnetic separator. Magnets are incased in water-tight box.

*Conclusion of the article published in the May 26 issue.

washed down over the foot wheel. As the ore travels up the belt, wash water is added, and as the ore passes from one pole to the other a loop from ½ to ¾ in. high is formed, the ore turning over in looping. Strong currents of wash water coming down the belt wash through the loops of ore, removing the non-magnetic material such as silica, mica, phosphorus, and low-grade slime. Thus the ore is not only separated magnetically, but is also turned over in passing from pole to pole, and, by the strong water currents, is also given a thorough agitation and washing.

At the Richard mill the ore is sufficiently unlocked at minus 8 mesh so that the machine will make a concentrate containing 60 per cent iron and a tailing containing less than 2 per cent magnetic iron. The feed contains particles of iron ranging from minus 8 mesh to 300 mesh and the machine successfully handles this feed. In experimenting with Richard ore it was found that by grinding the ore to minus 20 mesh a 67 per cent concentrate could be made with 1¾ per cent magnetic iron in the tailing. As 60 per cent iron concentrate is satisfactory to furnace men so far as iron content goes, and very satisfactory from the standpoint of size, it is considered better to concentrate the ore at minus 8 mesh than to concentrate it after it has been ground to pass 20 mesh. The added cost of grinding to 20 mesh and the fact that a considerable amount of ore would be made finer than 80 mesh more than offsets the higher-grade concentrate, especially as the tailing contains practically the same amount of iron.

These wet-belt machines, which are manufactured by the Dings Magnetic Separator Co., are made in two sizes. The smaller has a 30-in. wide belt and the larger size a 50-in. belt. The belts are the same as used on the high-intensity pulley conveyors which have a 2-in. high flange. The belts run at 200 ft. per minute and the machines have a capacity of three tons of feed per hour per foot of belt width. Two gallons of water per inch of belt width is used, as water mixed with the feed and as wash water, of which 80 per cent may be recovered and used over again by apparatus such as is made by the Dorr company. The magnets are set in a ventilated copper box which is water-tight. The concentrate which clings tightly to the belt is taken off underneath the head pulley by a corrugated cast-iron take-off roller which has a peripheral speed of 1,200 ft. per minute. The roller is energized at the point of take-off by two magnets placed just above the roller. In addition, a spray of water removes any pieces of concentrate which may accidentally get by the roller. The design and successful use of these machines marks the first attempt to construct a dustless iron-ore concentrating mill in New Jersey.

As a general thing, in mining and crushing New Jersey ores, 5 to 10 per cent of material minus 80 mesh is made, this material consisting mainly of the softer pieces of rock and containing little ore. With the old-style dry separators this material invariably found its way into the concentrate, and was rightly objected to by furnace men. With the new-type wet-belt machine this material is now thrown into the tailing, and, as a consequence, the concentrate contains 4 to 10 per cent less fine lean material and is much better liked by furnace operators. With the old-type dry-belt Ball-Norton separator it was impossible to treat mine fines without drying, as the ore comes from mines in a sticky or muddy condition. When the fine ore is dried, each particle of ore is covered with a heavy coating of dust, and the resulting concentrate, especially in the very fine sizes, is lean. Following is a comparison of the dry and wet separation of minus 8-mesh Richard ore, using Ball-Norton dry-belt and Roche wet-belt machines. Fifty samples from different parts of the mine were crushed and mixed to form a twenty-ton sample for testing.

Comparison of Dry and Wet Separation

	Ball-Norton Machine Dry Separation		Roche Machine Wet Separation	
Screen Sizes	Per Cent of Screen Sizes	Per Cent Fe in Concentrate at 212 Deg.	Per Cent of Screen Sizes	Per Cent Fe in Concentrate at 212 Deg.
— 8 + 20 mesh	34	54.06	37	55.16
— 20 + 30 mesh	22	57.03	22	69.03
— 30 + 60 mesh	20	62.61	20	68.31
— 60 + 80 mesh	14	59.01	20	67.22
— 80 + 100 mesh	7	51.03	½	66.41
—100 + 200 mesh	2	43.21	½	66.03
—200 + 300 mesh	1	41.16	½	61.09
	100	56.56	100	63.25

Feed, minues 8 mesh (0.084 in. opening) and plus 300 mesh. General sample of crude ore contained 48 per cent iron.

Result of test on dry-belt machine: Dry-belt concentrate, 56.56 per cent Fe; magnetic iron in tailing, 17.93 per cent Fe; ratio of concentration, 1.28 to 1; tons concentrate per ton crude ore, 0.778; and percentage of recovery, 91.75 per cent.

Result of test on wet-belt machine: Wet-belt concentrate, 63.25 per cent Fe; magnetic iron in tailing, 2.19 per cent Fe; ratio of concentration, 1.33 to 1; tons concentrate per ton crude ore, 0.750; and percentage of recovery, 98.90 per cent.

The result of the test shows the difference in efficiency of the two machines. In addition, use of the wet-belt machine reduces the amount of equipment in the mill, produces a better furnace product, and makes the mill dustless. Results are based on the magnetic iron in crude ore and tailing.

Hourly Capacities of Different Types of Fine-Ore Magnetic Separators

Ball-Norton dry-belt machine, 1 long ton feed per foot belt width
Roche type wet-belt machine, 3 long tons feed per foot belt width
Grondal tandem wet drums, 2 long tons feed per foot drum width
Magnetic log washer, 1½ long tons per foot washer width

Excitation of Magnets Regulated by Special Method

Direct current for excitation of the magnets is generated at 125 volts by a flat compound-wound motor-generator set placed in the motor room that adjoins the mill building. A counter-e.m.f. voltage regulator is used to regulate the current so as to have current going to the magnetic separators at as even a voltage as possible. As this is the first time an e.m.f. voltage regulator has been applied to such service, a description of its operation may be in order.

The secondary element of the regulator consists of a counter-e.m.f. motor, the armature of which is connected in series with the field of the direct-current generator while the motor field is separately excited from the generator armature bus. The cycle of operation is as follows: The voltage of the generator is raised to approximately 10 volts above normal. The control switch is then thrown in position connecting the armature of the motor in series with the field of the generator. As a result of the higher generator voltage the control magnet overcomes its opposing spring and opens its contacts, which also opens the shunt across the field of the motor and permits full field to be applied, causing it to develop a high counter-electromotive force. Inasmuch as this e.m.f. opposes that applied to the generator fields, the excitation is instantly reduced and the generator voltage is decreased. The pulling of the main magnet is likewise controlled: when the voltage reaches the value for which the regulator has been

adjusted, the main contacts close and short-circuit the counter-e.m.f. motor field, and maximum excitation is again applied to the generator field, which tends to raise the voltage. This cycle of operation is maintained at a high rate, the main contacts vibrating 500 to 800 times a minute, so that constant voltage is maintained no matter how much the load may vary. A resistance is connected in series with the field of the motor to limit the current when the contacts on the control magnet close and short-circuit the field. There is also an eddy-current brake excited from a coil connected in series with a generator field. Consequently, the brake effort varies directly with the generator field excitation, whereas the torque of the motor armature varies with the motor excitation. The combined action results in the speed of the motor being held well within the rated r.p.m.

The dry drums take current at 5 amperes; wet-belt separators at 6 amperes; high-intensity pulley machines at 31 amperes; magnetic clutch on secondary gyratory at 3 amperes, and ore-gate lifting magnets at 2 amperes. Each magnetic machine is equipped with regulating rheostat, ammeter and pilot lamp. Although a 25-hp. motor-generator set would furnish sufficient direct current for the magnetic separators in the present mill, additional capacity has been installed to take care of expansion.

Handling the Concentrate and Tailing

The various sizes of concentrate are collected and conveyed from mill to shipping bin by an 18 in. wide x 65 ft. long belt conveyor which runs at 300 ft. per minute. Fine concentrate is dewatered by a drag conveyor inclined 30 deg. No. 103 chain and sprockets are used for the drag; sprockets at the head and foot end are spaced 24 in. apart; the drag is 12 ft. long and runs at 50 ft. per minute; and ¼x4x24-in. plate is used as blades on the drag, the blades being fastened to the chain at every fourth link by *F*2 attachments. Forty-one-tooth sprockets are used at the foot wheel and ten-tooth at the head wheel. The drag is used to dewater concentrate only as a temporary measure until some more efficient dewatering device can be installed.

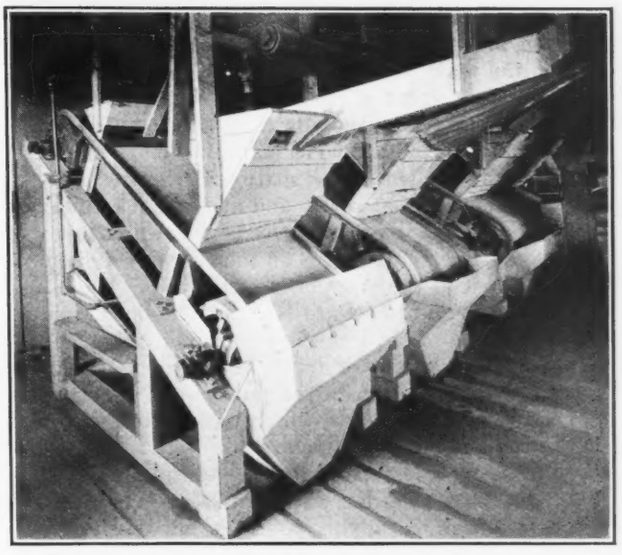
It is of great importance to produce concentrate in a coarse condition; if possible, all concentrate should be minus 1 in. and plus 80 mesh for furnace use. In the first place, as magnetite is slightly more refractory in furnaces than hematite, the pieces of magnetite should be small so as to be reduced quickly and with as little fuel as possible; and in the second place, any iron ore, either magnetite or hematite, may blow over if finer than 80 mesh.

Coarse tailing is collected in the mill by an 18 in. wide x 300 ft. long belt conveyor which runs at 300 ft. per minute. The conveyor is inclined at 20 deg. for about half its length; then flattens out and runs over the stockpiles, the flat part of the conveyor being 60 ft. above ground level. The fine tailing is conveyed by launders to a pond and there dewatered and stocked. From 2 to 4 per cent of the iron in the crude ore is lost in the tailing.

Waste Products Find Ready Sale

In concentrating iron ores crushed rock and sand are made as byproducts which find ready sale within a radius of 100 miles. Crushed rock is made in two sizes, —minus 2 in. plus ¾ in.; minus ¾ in. plus 8 mesh; and minus 8-mesh sand is also produced. The rock is sold at $1 per short ton and sand at 80c. per ton, f.o.b. mine. All the magnetic iron in the tailing can be recovered by very fine crushing, but it does not pay to grind fine, on account of the value of the coarse tailing. The average price per unit of iron today is 8c. and the value of coarse tailing, as crushed rock, is $1 per ton; therefore, the crushed rock has the same value as 12½ units of magnetic iron, exclusive of cost of finer crushing. Coarse tailing, as made today, contains but 2 per cent of iron as free magnetite, so the iron is worth only 16c.

In the Richard mill the waste or byproducts are made in following proportions when the mill is treating 42 per cent iron crude ore at the rate of 1,500 tons per twenty-four hours: Coarse rock, minus 2 in. plus ¾ in., 150 tons; minus ¾ in., plus 8 mesh, 150 tons. Sand, minus 8 mesh, 200 tons. Assuming 300 working



Battery of four Dings Roche type wet-belt magnetic separators

days per year, the total annual income from waste products is $138,000. With $38,000 for advertising, selling, and loading expense, the net value is $100,000. Of course, the geographical situation of North Jersey mines is a great factor in the sale of the waste products.

In mills that use wet processes, the finest product, the sand, is clean and especially suitable for concrete. Since the utilization of efficient high-intensity pulley type magnetic separators, which are used to effect the primary concentration, the coarse tailing is clean and remarkably free from iron ore. The crushed rock is suitable for concrete, railroad track ballast, water-bound macadam roads, and in making asphalt concrete. The sand is used for all classes of concrete, including sidewalks, as top coat on macadam roads, and for making products such as concrete sewer pipe, hollow tile, and brick. The gangue in the ore is almost wholly gneiss. The tailing is hard and of light color—desirable characteristics for the purposes mentioned. Camparative tests on gneiss tailing and trap rock show that gneiss stands considerably more pressure than trap rock. (See "Utilization of Waste Material," by A. W. Allen, *Engineering and Mining Journal-Press*, March 17, 1923).

Belt Conveyor Brush

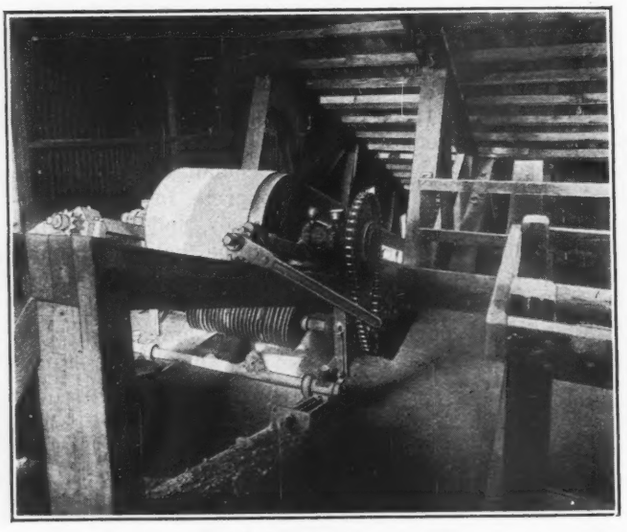
The type of conveyor brush used to clean the underside of conveyor belts is similar to the one described

by W. O. Borcherdt in "Handbook of Milling Details," published by the McGraw-Hill Book Co. Rattan brushes are not satisfactory as conveyor brushes except when the material conveyed is dry. The rubber disk brush is effective with both dry and damp materials. However, a new type of suspension has been devised for this brush. The rubber disk cleaner or brush is driven from the head wheel of the conveyor by a diamond roller chain and sprockets. The brush runs at 960 ft. per minute and is suspended from the head shaft of the conveyor much as a swinging cutoff saw is suspended. With this type of suspension, when take-ups are attached to the head wheels, the brush moves with the head wheel and always maintains the same position with respect to the head wheel.

Electric current for power is purchased from a public-service corporation, and is furnished at 2,300 volts, 3 phase, 60 cycles, at the mill. The power required to drive the mill shafting is 200 hp. A 200-hp. slip-ring induction motor is used, which is placed in a separate room on the main floor of the mill. A motor-generator set for direct current is in the same room, as well as a 15-cycle generator for the vibrating screen. There are six line shafts in the mill: The main line shaft, or No. 1, runs at 250 r.p.m. No. 2 line shaft is driven from No. 1 by a rope drive at 150 r.p.m. and a steel plate clutch is used so that No. 2 line shaft may be thrown out at any time. No. 1 line shaft drives all the crushers and No. 2 drives the rest of the machinery of the mill. No. 3 line shaft runs at right angles to No. 2, at 40 r.p.m., and is driven by a 10-in. belt merroy-go-round drive. Line shafts Nos. 4, 5, and 6 are driven from No. 3 and run at the same speed. Split cast-iron pulleys and bearings of the rigid ring-oiling type which set on brackets are used. Drop and post hangers are not used, as they have proved to be trouble-makers in heavy-duty mills.

Two 40,000-gal. wooden water tanks, set 20 ft. above the top of the mill, supply water for mill use and fire protection. Water is obtained from the mine pumping system. Apparatus for recovery of mill water is not necessary, as the mine furnishes more than twice the amount of water needed for mill and fire protection purposes.

The laboratory is furnished with the usual apparatus for making determinations of various elements in iron ores. The sampling and testing room is equipped with a 2x6-in. jaw crusher, a 5x8-in. crushing roll, and a No. 0, 6-in. grinder or pulverizer. These machines are driven from a line shaft which is driven by a 5-hp. motor. In addition, the sampling room is well equipped with apparatus for making screen tests, sampling, and drying ores. A magnetic tube tester used for determining the magnetic iron in crude ore and tailing is part of the equipment. This is a valuable machine for the purpose of determining mill efficiency and should be part of the equipment of every magnetic iron concentrating mill. The machine was developed at the Minnesota School of Mines Experiment Station. Samples of crude ore, concentrate, and tailing are taken by hand at half-hour intervals daily. Samples are taken from the different machines two or three times each week, and a close check is kept on all operations.



Conveyor-belt cleaner.

Manufacturers of Equipment

Main mill motor	Westinghouse Electric & Mfg. Co.	New York City
Motor-generator set	General Electric Co.	New York City
D. c. voltage regulator, switchboards and magnetic clutch on 8-in. gyratory—designed and installed by	Watson-Flagg Engineering Co.	Paterson, N. J.
Pan and belt conveyors and trommel screen	Stephens-Adamson Mfg. Co.	Aurora, Ill.
Vibrating screen and 15-cycle generator	The W. S. Tyler Co.	Cleveland, Ohio
Magnetic separators, high-intensity pulley machines, and switchboards	Dings Magnetic Separator Co.	Milwaukee, Wis.
Shafting, bearings, pulleys, and rope drive	Dodge Sales & Engineering Co. and Geo. A. Myers & Co., Inc.	New York City Paterson, N. J.
Transmission and 2-in. flanged belts used with the high-intensity pulley machines and wet-belt separators	New York Belting & Packing Co.	New York City
Conveyor belts	Goodyear Tire & Rubber Co.	Newark, N. J.
Laboratory crushers and grinder	Sturtevant Mill Co.	New York City
Primary crusher, No. 7½ Telsmith	Smith Engineering Works	Milwaukee, Wis.
8-in. gyratory and two 42x16 in. type "AA" heavy-duty fleeting rolls	Traylor Engineering & Mfg. Co.	Allentown, Pa.
10-ton crane	The Chisholm-Moore Mfg. Co.	New York City
Water tanks	The Baltimore Cooperage Co.	Baltimore, Md.
Endless rubber bands for magnetic separator drums	The B. F. Goodrich Rubber Co.	New York City
Asbestos-covered corrugated siding and asbestos shingles	Johns-Manville, Inc.	Newark, N. J.
Structural steel	Dover Boiler Works	Dover, N. J.
Electrical supplies	Newark Electrical Supply Co.	Newark, N. J.
Pipe, fittings, hardware, and mill supplies	Geo. A. Myers & Co., Inc.	Paterson, N. J.

In remodeling the Richard mill the old building was partly torn down, then enlarged and rebuilt. The following figures show the actual construction, equipment, and installation costs. Although the foundation costs appear high, it must be remembered that the old mill was on a fill, and considerable dump material had to be removed before new foundations could be put in. The new foundations averaged 24 ft. high. Included with foundations is the cost of supporting the old building walls while excavating for new foundations. There were 880 cubic yards of concrete in the new foundations and the total cost per yard was $13.12.

The cost of one 200-hp. motor, one No. 7½ gyratory crusher, a 3x20-ft. pan conveyor, one-half the cost of the trommel screen and two 24-in. drum separators are not included in the cost figures, as these items were on hand. The cost of complete new mill including these items is estimated at $165,000. The cost of engineering is not included, as so many factors entered into this that it was almost impossible to reduce it to dollars. However, as it is safe to estimate engineering at 10 per cent or more, the figure of $15,000 for such service may be used, and, therefore, the total cost of mill is estimated at $180,000.

Iron ores can be concentrated for less than other ores

such as copper, zinc, lead, gold, and silver. Only coarse dry crushing is required, and classification of ore before concentration consists of simple dry screening to three sizes. Most of the ore is handled in mills by gravity chutes, and the remainder by belt conveyors; elevators are not necessary, and conveyors can be driven by direct drive without gears.

Costs of the Richard Mill

	Labor	Material	Total
Dismantling and Remodeling Old Foundations			
Dismantling old building	$1,564	$1,359	$2,924
New Foundations			
Building and machinery foundations	$6,509	$5,037	$11,546
Construction Building and Ore Bin			
Mill building and ore bin	$12,685	$23,216	$35,901
Painting	1,080	809	1,889
Electric wiring and fixtures	253	641	895
Water system	470	2,246	3,716
Steam-heating system	423	845	1,268
Ten-ton crane	493	1,461	1,954
Total	$15,405	$30,220	$45,626
Outside Conveyor Supports			
Conveyor runs outside of mill	$2,743	$6,495	$9,238
Mill and Laboratory Equipment			
Crushers	$875	$14,776	$15,651
Conveyors and chutes in mill	2,790	10,635	13,425
Conveyors outside of mill	713	905	1,618
Screens	659	2,579	3,238
Magnetic separators	2,167	19,659	21,827
Motors and motor-generator set	169	3,751	3,921
Line shafting, pulleys and belts	1,488	8,478	9,966
Laboratory	637	1,959	2,596
Total	$9,500	$62,746	$72,246
Total cost complete mill	$35,723	$105,859	$141,582

The total milling cost at present per ton of crude ore in plants treating 1,500 tons per twenty-four-hour day, 300 days per year, and at a ratio of concentration of 1.5 to 1, is as follows:

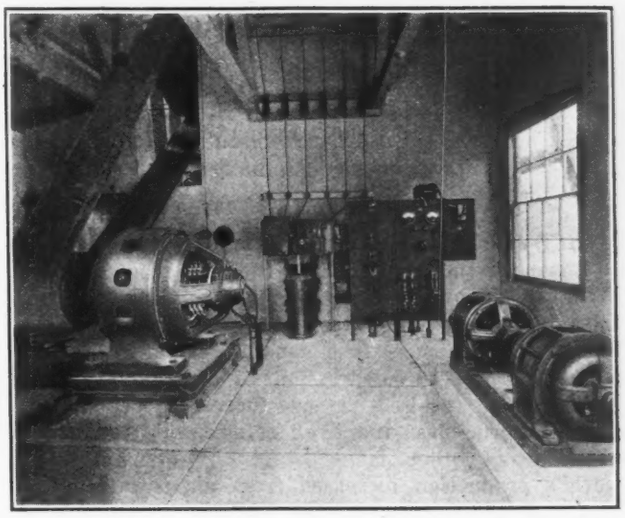
Mill labor	$0.040
Power for driving mills	050
Power for motor-generator set	.013
Power for laboratory work	.001
Depreciation of buildings at twenty years	.007
Depreciation of equipment at ten years	.018
Insurance and taxes—annual	.015
Repairs and renewals except labor	.030
Administration—general and local offices	.040
Water, lights, and steam heat	.010
Laboratory cost, except power	.010
Loading concentrate, except power	.004
Stocking tailing, except power	.004
Interest on investment of $180,000 at 6 per cent	.024
Total	$0.266

Operation cost may be divided into two parts—"direct operation" and "overhead." Direct operation includes labor, power, repairs, water, lights, steam heat, laboratory, loading concentrate, and stocking tailing, these items amounting to $0.162 per ton of crude ore. Overhead includes depreciation, insurance, taxes, administration, and interest on total investment, these items amounting to $0.104 per ton crude ore. Depreciation and insurance for dismantling and foundations is not included, but interest is calculated on the entire cost.

The following items in regard to the Richard mill are calculated on basis of twenty-four-hour operation, 300 days per year.

Construction cost per annual ton crude ore milled	40c.
Total hp. per ton crude ore per day	0.170
Tons crude ore treated per millman per day	125
Hp. per ton crude ore for excitation of separators	0.033
Gallons water per long ton dry feed for wet separators	480

Little lost time occurs in the operation of such mills, and repairs are generally made on Sundays. The mills are built as one unit, and when trouble develops the entire mill has to be stopped. However, two and one-half hours per working day is allowed for repairs, and it has been found that the Richard mill will handle 1,500 tons of crude ore in twenty-four hours with this allowance. The principal repairs are on crushers and screens,



Motor room

and these machines are handled by cranes. Repairs on magnetic separators, chutes, conveyors, shafting, pulleys, bearings, and belts are small and made at infrequent intervals.

In magnetic separation the run-of-mine ore is given a primary concentration, and middling made by the high-intensity pulleys is given a secondary and sometimes a third concentration. This applies only to ores coarser than 8 mesh. For ores minus 8 mesh, mine ore and crushed middling are given one separation after they pass the vibrating screen, so that the general separation process is simple. At the Richard mill all mine ore goes through the primary crusher, which is a gyratory set to 4 in., and this machine produces few fines. I prefer a jaw crusher to a gyratory as a primary crusher, but as the gyratory was on hand it was concluded to use it instead of purchasing a new jaw crusher.

Grade of Concentrate

The average screen sizes and chemical analysis of the three principal sizes of Richard concentrate when treating crude ore averaging 42 per cent iron were as follows:

Screen Sizes	Per Cent by Weight	Per Cent of Iron
—2 in. + ¾ in.	30	58.0
— ¾ in. + 8 mesh	30	60.0
—8 mesh	40	60.0
Total	100	59.4

Screen Sizes	Per Cent	Screen Sizes	Per Cent
— 2 in. + ¾ in.	30	— 30 + 60 mesh	4½
— ¾ in. + ½ in.	12	— 60 + 80 mesh	5
— ½ in. + ¼ in.	10	— 80 + 100 mesh	3
— ¼ in. + 8 mesh	8	—100 + 200 mesh	1
— 8 + 20 mesh	20	—200 + 300 mesh	½
—20 + 30 mesh	6	Total	100

In general, the iron product made at the Richard mill is a high-phosphorus concentrate running 60 per cent iron and 0.65 per cent phosphorus. The size of the concentrate is such that is is well suited for furnace use without agglomeration. The amount of minus 80-mesh concentrate is small, and sufficient moisture is present so that when charged into furnaces it becomes adhesive before it is blown over.

The Richard mill has now been operating six months and has had a thorough trial, or perhaps it might better be called a six months' educational period. So far as I can see there are no changes to be made in any part of the mill, with the exception of a more efficient dewatering device.

World Production of Graphite in 1922*

Revival of Industry—Large Stocks Must Be Absorbed—Tariff Should Help Domestic Producers

BY ARTHUR H. REDFIELD

RECOVERY from the depression of 1920 and 1921 marked the year 1922 in the mining of graphite. With but one or two exceptions, all the producing countries increased their output of graphite, both crystalline and amorphous. The general revival of industry after the post-war depression of 1919 and 1920 in Europe has resulted in an increased demand for graphite crucibles, foundry facings, lubricants, lead pencils, and other manufactures of graphite. The world's production increased from an estimated total of 85,000 metric tons in 1921 to an estimated total of 102,000 tons in 1922.

WORLD MARKET STAGNANT

The world market is still depressed, however, by the existence of large stocks of unsold graphite held by producers in Madagascar, in Ceylon, and in Alabama, as well as in the hands of German, French, British, and American dealers. These stocks represent for the most part an overproduction of graphite in 1917 and 1918, and an accumulation of unsold output of the years 1919, 1920 and 1921, when the demand for graphite fell below normal. These stocks, of which no exact totals are available, must be absorbed before the graphite industry of the world will be on a stable basis. The following table gives the world production from 1919-1922:

World's Production of Natural Graphite, 1919-1922

In Metric Tons

	1919	1920	1921	1922
United States (*a*)				
Amorphous	3,065	4,258	1,671	(*f*) 1,996
Crystalline	3,668	4,369	540	(*f*) 839
Canada (*a*)	1,199	1,987	361	(*f*) 590
Mexico (*c*)	4,995	3,319	3,088	1,993
Austria	8,265	11,543	13,280	(*b*) 11,650
Czechoslovakia	31,234	(*b*) 15,000	(*b*) 12,000	(*b*) 13,000
Germany	30,525	20,639	(*b*) 30,000	(*b*) 35,000
Italy	7,626	5,398	(*f*) 5,750	(*f*) 7,300
Spain	1,958	6,315	2,772	(*d*)
Ceylon (*c*)	6,778	9,352	4,419	10,190
Japan	1,954	1,135	(*e*) 842	(*b*) 1,000
Chosen (*c*)	12,945	18,259	8,015	13,352
Madagascar	4,983	4,000	Negligible	Negligible
Other countries	8,442	1,574	(*d*)	(*d*)
	127,637	107,058	(*b*) 85,000	(*b*) 102,000

(*a*) Shipments. (*b*) Estimated. (*c*) Exports. (*d*) No data. (*e*) Unofficial. (*f*) Preliminary.
United States figures compiled by Mrs. L. M. Beach, U. S. Geological Survey.

The mining of graphite in the United States in 1922 still showed the effects of the post-war depression. The new tariff, designed to protect the American industry from competition with low-priced foreign graphite, did not go into effect until Sept. 21. A small gain in production took place, however. Imports increased from 8,183 short tons in 1921 to 12,606 short tons in 1922.

Graphite mining in Canada and in Mexico shared in the depression which the industry underwent in the United States. Shipments from Canada and from Mexico into the United States were small during the entire year 1922.

The graphite industries of Austria and of Czechoslovakia depend rather on the German than on the domestic market. Sales of Styrian graphite on both the domestic and the foreign market decreased in 1922. A similar depression was felt in graphite mining in lower Austria. This is ascribed to a rise in railroad rates, which placed the Austrian and Styrian producers at a disadvantage on the German market as compared with the Bohemian and Moravian producers, who are nearer at hand. This difference resulted in a decreased production in 1922 in the Austrian Republic and an increased production in Czechoslovakia.

Statistics of imports and exports of graphite and graphite products in Germany in 1922 indicate an increased consumption of graphite. The net exports of crucibles gained considerably in 1922 over the exports of 1921, but did not, however, equal those of pre-war years. The net exports of lead pencils from Germany in 1922 fully equaled those of 1913. The manufacture of lead pencils in 1922 was hampered, according to C. E. Herring, United States Commercial Attaché, by the difficulty of securing raw materials, particularly Ceylon graphite and cedar wood, owing to the depreciation of German exchange and the lack of capital.

The German production of graphite in 1922 is estimated at 35,000 metric tons. As in the preceding year, the depreciation of the mark in German exchange protected the Bavarian graphite producer from strong competition from Ceylon or Madagascar graphite.

INCREASE IN CEYLON AND CHOSEN PRODUCTION

The Ceylon graphite industry was revived by the increasing demand. A total of 10,190 metric tons was exported from the island in 1922. About 64 per cent of the 1922 exports, according to figures of the Ceylon Chamber of Commerce, were made to the United States. Stocks on Jan. 1, 1923, were officially estimated at 15.100 tons.

Exports from Chosen in 1922 increased markedly over those of 1921 and even surpassed those of 1920. During 1922, Chosen exported 1,717 metric tons of flake graphite, and 17,645 metric tons of amorphous graphite. About 95 per cent of these shipments went to Japan, to be for the most part manufactured or re-exported. A revival in the Japanese lead-pencil industry, which consumes a large part of the graphite imported from Chosen, is indicated by increased exports during the first eleven months of 1922. The situation in Madagascar shows no sign of improvement. Stocks held in the colony on Jan. 1, 1922, were officially estimated at 18,000 to 20,000 metric tons, or at the same amount as at the beginning of 1921. Exports during 1922 probably did not exceed 6,600 tons, as compared with 6,220 tons in 1921 and 4,425 tons in 1920. The 1922 exports were almost entirely out of old stocks. Shipments to Great Britain comprised chiefly the purchases of a single crucible manufacturer; shipments to France and Germany were on consignment. Little or no graphite was mined in the colony during 1922.

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Building Industry Using More Copper

Consumption of copper in building construction is now on a basis of 230,000,000 lb. a year, according to a survey just completed by the Copper and Brass Research Association. This compares with a 1922 consumption of 150,000,000 lb. and 100,000,000 lb. in 1921. Among other interesting data developed by this survey is the fact that a total of 5,175,000,000 ft. of leaders and gutters are now in use on residence buildings in this country, and that 4,120,000 home owners renewed rusted leaders and gutters last year. In making these replacements, 61,805,500 lb. of copper was consumed.

Standardizing Drill Steel at Copper Queen Mines

Number of Sizes and Shapes Reduced—Shop Practice Improved —1-In. Round Hollow Lugged Section Adopted, With $\frac{1}{16}$-In. Gage Change and 15-In. Run

By Arthur Notman
Consulting Mining Engineer, 170 Broadway, New York

In 1915 the following drill steels were in use at the Copper Queen mines: 1¼-in. round hollow lugged steel, 1-in. solid cruciform shankless, ⅞-in. hollow hexagonal collared, and ⅞-in. hollow hexagonal shankless. The first was used in the drifting machines, the second in the dry stopers, the third in the jackhammers, and the fourth in the wet stopers. The use of the so-called stoping machines was confined to the driving of raises, and the actual stoping was carried on with the drifting and plugging machines.

It was felt that a material saving might be made by reducing the number of sizes and shapes. Experiments were begun to obtain the requisite data. The demand for increased production brought about by the war postponed the completion of these tests until 1919, when they were resumed. A decision had already been reached to discard all dry stoping machines, as they were worn out, replacing them with wet as required.

The first question which presented itself was, what one size and shape of steel, if any, could be used in all three types of drills without a net loss in drilling speed in the machines in use.

We had been in the habit of using our dies, dollies, and formers for three months or even longer without taking into account their real condition, because the cost of poor steel in the mine was not appreciated, whereas the direct cost in the shop was constantly before the management. As a result, within a few weeks after a new set was installed, the product began to suffer from all the ills known to the blacksmith shop. Finally, after perhaps three months, the complaints from the mines would come so thick and fast, that the tools would have to be changed, regardless of shop expense. Study indicated that the life of these tools in good condition was from two to three weeks. Accordingly, this was adopted as the standard life for them. They had to be changed at the end of that period whether they needed it or not.

Pyroscope Adopted for Checking Temperature

The question of temperature control was the next subject of investigation. We tried out a furnace controlled by an electrical pyrometer. This worked fairly well on tempering, but when used as a forging furnace was out of order most of the time. With pressure for economy in the shop, a very high speed had been developed. This resulted in forging much of the steel at altogether too high a temperature. Consequently, it did not give proper service. The emphasis at the shop was transferred from quantity to quality with gratifying results in the amount of steel required per unit of work underground, and there was no increase in the total shop expense.

To check temperatures, we bought a Shore optical pyroscope. This showed that the tempering furnace was doing excellent work, but that in the forging furnace the steels were all coming out at temperatures running from 1,850 to 2,200 deg. F. Our information led us to believe that though it was preferable to forge at about 1,750 to 1,800 deg. F. no particular harm would result to 0.80 to 0.90 carbon steel until the temperature exceeded 1,950 deg. F. At the lower limit it is difficult to forge in one heat, whereas at 1,850 deg. to 1,950 deg. good bits can be readily formed in one heat. We found the pyroscope valuable in maintaining this control. Part of this effect was undoubtedly psychological. Oil-fired furnaces were being used, which were double-sided. In them temperatures and atmosphere could be controlled with difficulty. With the advice of the Ingersoll-Rand Co., we rebuilt them, making them single-sided. They were arranged so that we could read the temperature of the bits with the pyroscope while they were in the furnace.

1-in. Round Hollow Lugged Section Adopted

At the same time as these studies and changes in our shop practice were made, the question of shanks as well as bits being included, we took up the original question of size and section of steel. Theoretically the round section is the strongest per unit of area that can be made. Practically, this strength is modified by the amount of damage done to the steel by upsetting to form the lugs or a collar for rotating the steel. The fitchering nature of the ground in the Bisbee district makes it desirable to have some positive method of withdrawing the steel from the bore holes. It is customary to equip machines using round steel with slotted chucks to take the lugs, rather than with external retainers and collared shanks. It is doubtful whether, if proper care is used, any more damage is done to the steel in forming the lugs than in forming a collar. So far as we were able to determine, there is no really satisfactory external retainer on the market. Another advantage of the round section, which developed later, is the reduction in hole friction and consequent better rotation and increased drilling speed. This advantage is aided by the better alignment of the steel in the hole due to the longer bearing required in the slotted chuck, compared with that in chucks designed for collared shanks and external retainers.

With these conditions in mind, we selected the 1-in. round hollow lugged section for experiment to determine whether it could be used in all types of wet machines without loss of economy. These experiments showed that in the drifting machines using 1¼-in. steel there was a great increase in drilling speed with the lighter steel, no increase in breakage, and a large saving in weight. In the plugger type, there was no apparent loss in drilling speed in changing from the ⅞-in. hollow hexagonal collared steel to the slightly heavier 1-in. round hollow lugged steel. In fact, the rotation was improved through the better alignment due to the longer front head required and the lessened hole friction with the round section.

The use of stopers at the Copper Queen is confined entirely to the driving of raises. We were advised by the drill companies that the use of lugged steel in the stopers would necessarily result in great wear from the sludge in the front end. Our experience has not conconfirmed this opinion.

One other point, which we regarded as essential to obtain good results, was to insure that the hole in the steel should be centrally located and at least approximately round in section. A survey of the manufacture of hollow drill steel led us to believe that it was easier to obtain such a hole in the round than in any other section.

Other changes which resulted from improved shop practice were the reduction in gage change from $\frac{1}{8}$ in. to $\frac{1}{16}$ in. and standardizing on a 15-in. run. The question of the proper finishing size is still in doubt, and is awaiting further experiment to determine what effect the size of the bottom of the hole may have on the efficiency of the explosive used. This point is undoubtedly a matter of compromise between efficient drilling and efficient breaking.

To illustrate the saving to be obtained by reducing the size of the steel used, I cite the following example: The weight of 1¼-in. round hollow drill steel is 3.98 lb. per ft., whereas that of 1-in. steel is 2.48 lb. per ft. Six sets of four steels each will be needed to reach the desired depth, using a 3-ft. starter and 15-in. run. We would then have in the first case, 465.7 lb. of steel to be transported to and from the shop and lifted in and out of the machine, and in the second case only 290.3 lb. or a saving of 37½ per cent in the weight handled.

Similarly, if through improvement in the quality of the steel the change in gage can be reduced from $\frac{1}{8}$ in. to $\frac{1}{16}$ in., and the length of run increased from 15 in. to 18 in., the following economies would result: Assuming the same conditions as before, the reduction in gage would save 11.3 per cent of the ground to be cut to reach the same finishing size. Only five sets might be required for the round, on account of the increased run, or a reduction of 16⅔ per cent in the amount of steel to be handled.

The question of the quality of steel to be used in rock drills is a matter of great importance to the industry, but it cannot be safely attacked until we are certain that our shop practice leaves nothing to be desired. If not, we will be badly confused as to the meaning of tests on steels of different composition or different method of manufacture. Consequently the first step toward improvement should be to put the shop on a sound basis, by giving it the careful study that it deserves, and then see if we cannot adopt some one size of steel and design of shank to fit every condition which we may encounter in our particular mine. Preferably, this should be the lightest which will permit the finishing size of our average depth hole to be large enough to insure economy in the explosives used, without too much breakage of steel. The reduction in gage should be a minimum and the length of run a maximum per change. The proper balancing of these factors is undoubtedly a question for study and determination in each individual case. But we must bear in mind that, if we want to reduce the cost of the supplies which we consume, we should try to reduce the number of sizes and shapes which we call on the manufacturer to supply to the industry as a whole. Standardization, like charity, begins at home, and, like charity, it is generally harder to find there than anywhere else.

Silver Mining Costs of the McKinley-Darragh-Savage Mines

An unusually complete record of the cost of silver production in Ontario is given in the 1922 report of the McKinley-Darragh-Savage Mines, of Cobalt, from which the following details have been taken. Silver recovered during the year amounted to 297,033 oz., of which 254,307 oz. was shipped. Costs are given as follows:

Operations

	Per Ton of Ore Mined	Per Ounce Recovered
Insurance, taxes and administration	$0.851	$0.0742
General charges at Cobalt	0.334	0.0291
Mining	1.732	0.1510
Milling	1.709	0.1490
Sampling and assaying at Cobalt	0.093	0.0081
Bagging and shipping	0.074	0.0064
Operating camps	0.026	0.0023
Surface work and roads	0.061	0.0053
Alterations to plant	0.136	0.0119
Prospecting	.....	.....
Surface dumps	0.008	0.0007
Salvage	0.051	0.0044
Production costs	$5.075	$0.4421

Milling details and costs are subdivided as follows:

Mill Report

Possible running time	266,400 stamp hours
Time lost	64,361 stamp hours
Actual running time	202,039 stamp hours
The mill ran 75.84 per cent of the possible running time.	
Total tons treated	25,848
Average tons per day	120.22
Ounces of silver recovered in mill	263,073
Average mill heads	12.113 oz. per ton
Average mill tails	1.946 oz. per ton
Percentage of extraction	83.97 per cent
Ratio of concentration	89.64 to 1

Milling Costs

Operations	Per Ton Milled	Per Ounce Recovered
Treating	$0.817	$0.0803
Repairs	0.477	0.0469
Power	0.418	0.0410
	$1.712	$0.1682

The McKinley-Darragh-Savage mill is a 200-ton stamp-mill and flotation unit.

Milling Results at Inspiration

From Feb. 11 to Dec. 31, 1922, an average of twelve sections of the Inspiration concentrator in Arizona were in operation. The annual report of the Inspiration Consolidated Copper Co. gives the following details regarding milling results:

Dry tons of ore milled	3,667,495
Tons treated per day of milling operations	11,437
Average number of sections running	12
Average rate per section, tons	954
	Per Cent Copper
Screen analysis of mill feed to concentrating machines (on 48 mesh)	4.2
Assay of mill feed—copper	1.228
Oxide copper in mill feed	0.210
Assay of general mill tailing	0.272
Oxide copper in general mill tailing	0.187
Smelter assay of concentrates produced	26.213
Assay of flotation concentrate	31.43
Assay of table concentrate	9.05
Moisture in general concentrate	15.37
Ratio of concentration	27.5
Recovery of copper in milling (smelter assays) calculated from assays only	78.67
Assays and weights of concentrate and ore	77.71
Assays and weights of concentrate and tailing	78.49
Recovery of copper sulphide in ore	91.96
Fresh water used per ton of ore, tons	2.095
Power used per ton of ore milled	Kw.Hr.
Coarse crushing	0.53
Fine grinding and concentrating	10.44
Blowers for flotation air	2.34
Filtering and reclaiming water	0.76
Lighting	0.12
	14.19
Steel ball consumption in fine grinding, per ton of ore milled, lb	1.75
Flotation oil consumption per ton of ore milled:	
Coal tar, lb	0.968
Sundry oils, lb	0.108
Total, lb	1.076

The Perth Feldspar & Mining Co's. quarry in Ontario

A New Deposit of High-Potash Feldspar in Ontario

The Perth Feldspar & Mining Co.'s Quarry in Lanark County —High-Grade Product—Little Mica, Pyrite, or Tourmaline —Only Five Miles From Railroad—Development to Date

BY A. M. CAMPBELL

IN DECEMBER, 1921, my attention was drawn to what is probably the largest known deposit of high-potash feldspar in Canada. It is situated in the Township of Bathurst, County of Lanark, Province of Ontario. Our operations have so far been confined to a phenomenal dike of feldspar, 1,000 ft. long and 300 ft. wide. This mass of spar rises to a height of from 40 to 60 ft. above the main highway that intersects the property. Regardless of what there may prove to be on the remainder of the 100-acre property, there may be many hundreds of thousands of tons of marketable feldspar in the hill alone. The timber has been cleared from an acre or two of the hilltop, and even that part of the deposit could doubtless supply sufficient spar of the quality required for the ceramic industry to satisfy the requirements of American importers for a long time. An inspection of it has satisfied the expert representatives of several American grinding concerns that a deposit of high-potash feldspar has been found that can fill the largest requirements and remove all anxiety on the part of customers regarding the question of permanency of supply.

Deposit Seems Large

This deposit forms part of an intrusive mass or "belt" of pegmatite that can be traced across that part of Bathurst Township for a mile or two. Here the greatest development of crystallization is found—the feldspar differentiation having occurred on a scale of unusual magnitude. As usual, this dike does not consist wholly of good material, but presents a multitude of segregations of coarse crystals within its mass. This coarse crystallation usually occurs in large dikes when they cut hard rocks, such as granites and gneisses—as this one does. The ore here consists of the orthoclase variety and ranges in color from white, through pink to red. Although we are at present mining pink and flesh-red spar, we recently uncovered, in a near-by part of the dike, a pure white high-potash spar similar to the highest grade ore coming from the Buckingham deposits. This we propose to open later—when it is required for the electric insulator trade and a suitable price can be obtained.

Impurities Are Unimportant

Regarding impurities, I may say that there is, on the whole, less quartz than usually occurs in such dikes. Mica seems to be practically absent, and the amount of other accessory impurities, such as tourmaline, pyroxene, and pyrite, is negligible. In several places there is a graphic intergrowth of quartz, but the proportion is not sufficient to affect appreciably the quality of the spar. In our largest opening, we encountered a zone of oxidation, with its accompanying discoloration, which extended for some distance in depth. An open crack or seam was filled with earth and yellow ocher, which had more or less permeated the adjoining spar by means of its cleavage planes. Some of the ore was also much decomposed. However, we have now got below any surface contamination, and the pit bottoms in high-grade spar. In an adjoining opening we are preparing to take out a large tonnage of No. 1 grade crystal spar.

A representative analysis of our ore, made at the laboratory of the Mines Branch, Department of Mines, Ottawa, gave the following results:

Constituent	Per cent
Silica	65.10
Ferric oxide	trace
Ferrous oxide	.11
Alumina	21.50
Lime	.11
Magnesia	.06
Oxide of potassium	12.81
Oxide of sodium	.58
Total	100.27

At the request of the representative of one of the large industrial concerns in the United States, which, I understand, uses several carloads of ground spar a

week in the manufacture of high-tension insulators, I made a shipment of our pink spar for testing purposes, and its porcelain-production superintendent reported that "the samples so far tested are encouraging."

Transportation Facilities Good

This spar is hauled by wagon or sleigh about five miles to the Canadian Pacific Railway station at Glen Tay, situated four miles west of Perth, Ontario. A comparatively level and good road from Glen Tay runs through the property. About 200 yd. of new road was built to connect the hilltop workings with the main highway.

A hydro-electric transmission line passes within half a mile of the deposit and can be tapped when such power is desired. In the meantime, cheap power is obtained through the burning of wood fuel, of which there is a plentiful supply on this and adjoining properties.

A creek flows along the west side of the feldspar hill, and there are also springs near by, affording an ample supply of water. Nearly all the miners and teams required can be secured in the neighborhood.

Future Looks Promising

The property is now equipped to provide for a large production. Sufficient development has been done to satisfy not only the owners, but also practical experts representing American and Canadian corporations, that this deposit is capable of the consistent shipment of large amounts of merchantable feldspar. It is from such a quarry that all large users of feldspar wish to draw their supply. From now on, we expect to produce an ever increasing tonnage of high-grade spar. As this orebody, like the well-known American deposit near Keene, N. H., stands nearly vertical, there seems no reason to suppose that it will not continue in depth as far as it will prove profitable to mine it. To indicate the possibilities in this direction, it might be noted that in Norway one quarry has reached a depth of nearly 600 ft.

Composition and Uses of Zinc Dust

In an article on zinc dust and its uses appearing in *L'Industrie Chimique* of Aug. 18, 1922, it is stated that powdered zinc owes its extended use to the following properties: 1. Reducing properties, utilized particularly in the dyestuff industry. 2. The property of precipitating metals, such as copper, cadmium, lead, silver, and gold, from their solutions. Interesting applications are its use in the purification of zinc sulphate solutions for the electrolytic extraction of metallic zinc, or for the manufacture of lithopone, and for the precipitation of gold and silver from cyanide solutions. 3. The property of combining with dry oxygen only at a high temperature, and of giving with moist air a basic carbonate, or with sea water an oxychloride, which protects the bulk of metal from further alteration. Zinc powder is thus used for: painting iron objects; galvanizing by cementation (Sherard's method of immersing iron objects in zinc dust at 300 deg. C.); and cold, or electrolytic galvanizing of cast iron.

Zinc dust is far from pure zinc, as the following partial analyses will show:

Sample No.	1—5	6	7	8
Zn metal	79.1 to 88.7	46.1	76.7	31.2
ZnO	6.6 to 11.2	48.5	20.1	48.3
Pb	1.9 to 2.5	6.1	0.2	2.9
Cd	0.1 to 1.8	0.1	0.07	0.13
Fe	Tr. to 1.3	0.58	0.05	1.80
O	0.5 to 4.10	....	....	4.31
I (insoluble)	....	3.28	2.32	....
SiO_2	Tr. to 0.22	....	....	3.58

Samples 1 to 5 were obtained by the ordinary retort furnace metallurgical process, the sixth is a crude dust from the Scandinavian electrothermic process, the seventh is a refined thermoelectric product, and the eighth is a special zinc dust made in the electric furnace from a non-calcined blende.

The grains of zinc dust are metallic globules surrounded by crystals of zinc oxide. It is this coating of zinc oxide which prevents the separate droplets of metallic zinc from reuniting, thus making possible the obtaining of zinc dust by direct condensation.

Costs of the Miami Copper Co.

The annual report of the Miami Copper Co. with customary liberality gives the following information about its costs:

Following the policy of curtailment initiated in 1919, an average of less than five mill sections was operated. The results of these operations were as follows:

Ore milled	2,183,020 tons @ 1.883 per cent copper
Concentrate produced	81,425 tons @ 43.601 per cent copper
Copper in concentrate	71,004,668 pounds
Copper per ton ore	32.526 pounds
Mill extraction	86.36 per cent

The cost of milling ore to the point of concentrate on board cars is as follows:

Direct crushing expense	$0.30717
Direct concentrating expense	.24786
Tailing and concentrate handling	.03474
Water for concentrating	.04637
Miscellaneous expense	.00803
Total	$0.64417

The total milling cost dropped approximately 6c. per ton, compared with the previous year, the lower cost being due principally to the larger tonnage treated per section. Metallurgical results during the year were the best in the history of the property. The mill handled a considerably greater tonnage per section and made a copper extraction of 86.36 per cent.

From an operating point of view, the most important development during the year in the mill was the installation of new equipment and the introduction of a new flow sheet in one of the mill sections. Six months' operation of this new flow sheet demonstrated an increased capacity of 20 per cent, with a lower tailing loss.

The new tailing elevating plant, consisting of a battery of six Wilfley sand pumps, which was installed in December, 1921, operated successfully and with considerable economy during the year.

The smelter returns of refined copper on the concentrate shipped amounted to 67,454,447 lb., and the cost of this copper in concentrate on board cars at Miami was as follows:

	Per Ton Ore	Per Pound Copper
Mining	$1.11304	$0.035993
Milling	.64417	.020847
General	.29975	.009704
Total	$2.05696	$0.066544

This shows a decrease in all departments, compared with the previous year, of approximately 18c. per ton, which, coupled with a higher yield, has resulted in a net decrease of 1.2c. per lb. of copper.

Ore Reserves

Little new ore was developed during the year 1922, although 37,673 tons of ore was mined from outside the calculated reserves. It is estimated that on Jan. 1, 1923, the ore reserves stand as follows:

High-grade sulphide ore	6,756,187 tons @ 2.26 per cent copper
Mixed sulphide and oxide ore	6,000,000 tons @ 2.00 per cent copper
Low-grade sulphide ore	36,000,000 tons @ 1.06 per cent copper

Operations at the Buck Passer Mine

A Profitable Little Mine Somewhere Out West—What Happened When a New Management Applied an Overdose of Systematized Supervision

BY AN OCCASIONAL CONTRIBUTOR

THE PROPERTY with which this story deals was started under the name of the Buckskin mine. It was developed by an adit, at the mouth of which was built a twenty-stamp mill with vanners, cyanide plant, compressor, sawmill, and electric-generating plant, all driven by water power. The exact geographical location of the mine is immaterial.

The vein was from 2 to 6 ft. wide. The company had 700 ft. of backs, with a pay shoot about 800 ft. long. The ore averaged $18 per ton; it was mined with stoping drills; the cost for mining, milling, and development averaged about $4 per ton, and the mine was making a net profit of $12.50 per ton treating fifty tons daily. The property was owned one-half by eastern people who had put up the capital and the other half by western men who had discovered it and were operating it. The mine for three years had been paying $15,000 a month in dividends and carrying over a good surplus. The company paid good wages, fed the men on the best there was, carried a few prospectors on its payroll every winter, and always had a couple of meals to spare for a prospector or a man who came hunting work. If a man got hurt the superintendent generally let his pay go on if he was worthy, and everyone in the district had a good word for the management. The policy as shaped by the western owners was liberal but not extravagant.

EVERYONE WAS HAPPY

The men were contented, and in the three years of operation no labor trouble had ever been known. The superintendent was a level-headed chap who could say yes or no and say it "quick," but usually he put a lot of responsibility on his foremen and looked to them for results. As the vein was being developed by sinking, the promise was for a long life for the mine, and each of the six owners was getting $2,500 monthly and everyone was happy.

Then one of the eastern owners died and his estate fell to his son, who was an eastern business man, and at once he began to criticize the so-called easy-going western methods and demanded that the mine be incorporated for the usual one million shares, par value $1, and that the name be changed to the "Eastern Gold Mining and Development Syndicate, Ltd." The western owners consented, and things went on much the same as before. One of the western owners died, but his stock was divided between his widow and sons, who went along collecting dividends as usual.

Finally the young eastern man visited the mine and began to snoop around asking the men questions regarding operations and making a nuisance of himself generally. The superintendent heard of it and suggested that he could get all the needed information direct from him. The young man replied that he owned one-sixth of the mine, and, as the superintendent was one of his hired employees, he reserved the right to do anything he chose around his own property. He mentioned the matter to the two western owners, whose reply was that Henry was the boss and they looked to him for results, and it was not proper to go to his men asking questions about the management.

OPENING OF A NEW YORK OFFICE

Then the young man got busy and found one of the western boys who had inherited some of his father's stock. He offered him a price far beyond its value, made the purchase, and left for the east. By telling stories of incompetence and extravagance he prevailed on the eastern men to hold a meeting and assume control and give the mine intelligent supervision. They elected a new board and opened the usual New York office for the president and secretary, with a bookkeeper and stenographer, and began to look around for Henry's successor. Finally they settled on a young man who had married into one of the families and who had held positions in some of the various "boards" during the war. They elected him General Manager (big G and big M), and he in turn selected a superintendent, formerly with an iron mine. They went West and took charge.

They very wisely retained the old foremen and bookkeeper, but told them frankly that their system was all wrong. Then the General Manager proceeded to systemize things, and, as his training had been along the lines of plenty of titles, committees, and red tape, he began by calling the assayer Chief Chemist, the machinist Master Mechanic, the mill foreman Chief Metallurgist, the bookkeeper Chief Auditor, and the mine foreman Chief of Underground Operations. He instructed each of these departmental heads to select one of their best men and that either he or the superintendent would be the third member of a set of committees that would decide all questions of policy and procedure.

The General Manager then sent East and hired a young mechanical engineer and a cost clerk who had been in some of the various boards with him. Well, the foremen did not know just how to take it, so they went to the former assayer, who was a sort of a Mining Camp Solomon, and had done his bit to "make the world safe for—etc." He pointed out that the new manager wanted to run things along the lines in which he had been trained. "I know a little about that, and my advice is to play his game in every way, say but little, and do exactly as you are told," advised the assayer.

THE COMMITTEE ORDERS SOME CYANIDE

Well, after the committees had been perfected, affairs ran along much the same for a short time. Then things began to happen. One evening the mill foreman came in and said to the bookkeeper, "Jim, better order some more cyanide." The manager spoke up and said, "In the first place you will address the chief auditor as

Mr. Watson. He is your superior officer and you must show him proper respect. Besides, all supplies ordered must have a requisition made out which will be referred to the purchasing committee. What are your specifications for the cyanide?" The foreman replied, "Why just cyanide the same as we always get." The manager said, "I will get a specification from Washington showing analysis of the proper cyanide for us to use," and then asked where they had been getting it. The bookkeeper said "From A. B. & C., who handle most of the cyanide used on the coast. Besides, a while ago when it was scarce they even sent to Mexico and got hold of a couple of tons for us and did not charge anything extra." The manager said, "That is all past, and business is business; you may order a small lot, and in the meantime I will get specifications and we will advertise for bids, and right here I will say that in the future all supplies must be specified and bids must be advertised for."

Advertising to Sell Junk

The next morning the bookkeeper handed the manager a letter from a local foundry in a near-by town offering to buy their old cast scrap at $23 per ton and to come after it with their own truck. The manager ascertained that they had about ten tons on hand and said: "It will never do to sell anything without advertising." Ultimately the committee requested the bookkeeper to advertise. This finally resulted in selling the scrap at $25 to a junk man, but it cost $7 to gather and deliver it. This loss of $5 per ton was pointed out to the manager, and his reply was that the only way to sell material was in a way which precluded any criticism that any certain person or firms were being favored.

The machinist reported to the superintendent that he had a blueprint of new idler for the compressor belt which called for bearings to be lined with No. 1 Bozo metal. The superintendent said, "Get your committee man and go up and see the mechanical engineer." They all went to the manager, who said, "If Bozo metal is called for, it must be used." The machinist said, "It's all done but babbitting, and I have some good babbitt that I cut out of some old bearings before we junked them, and we have none of the Bozo stuff on hand." The manager replied, "Make out a requisition for it and delay work until it arrives."

Friendliness With One's Neighbors

One day a man came over from a neighboring mine bringing a piece of 2-in. pipe on which he wished to cut a thread, explaining that they had broken their die. The manager said, "You must go back and get an order signed by your superintendent." This the young man did, returning later. The manager turned it over to his stenographer to write on it "Referred to superintendent," who in turn referred it to the work committee, who sent the neighbor to the machinist. The latter, knowing the young man, handed him the die and said "Cut it yourself," which he did in five minutes.

The manager was in the commissary and saw an old prospector getting some supplies: as he started away he said: "Johnny, put these on the book until I have better news, which won't be long now from the way it's panning, and then, Johnny, I'll be buying canned peaches and sardines, and me boy you'll get all me trade." Johnny replied, "Well, good luck, old-timer." The manager heard this bit of dialogue. He stopped the old man and asked the clerk for particulars. He said the former superintendent used to trust two or three old prospectors, and if they could not pay he gave them some job around the place and let them "work it out." He used to figure that these old chaps were likely to open up something good and that the company could get a bond at a reasonable figure. No telling when some such prospect might, with development, make a mine. The manager replied: "We are not here to gamble on uncertainties, but I will refer this matter to the proper committee." He did. They reported that in due time they would examine the old man's prospect and if it was worthy of it they would recommend that he be given the credit he asked. He asked for a job to earn some grub, but they could not give it to him, so he went to another mine and was helped along.

The manager then issued orders that no more credit was to be extended, nor any more meals served outsiders unless they had meal tickets, which could be obtained at the office for cash.

The bookkeeper informed the manager that it was time to get in 200 cords of wood for mill and camp use. The manager said, "Refer it to the fuel committee," who instructed one of the members to get specifications from the mechanical engineer. These read: "Two hundred cords of dry pine or fir wood, both ends sawed square, four feet long, all to be body wood and no sap wood, bark or limb wood allowed; all to be delivered and piled and all subject to inspection." The manager handed it to the bookkeeper, who replied, "Not much use advertising this, as these woodchoppers are not very literary, and I don't think they will see it; besides, these specifications will mean a lot of waste and make the wood very costly." But the manager would not allow it to be changed. Finally a contract was taken and wood was delivered. After a lot of inspection and rejections it was finally settled for, but when the contractors had paid for part of the labor and supplies they had to sell their teams to square up and they were all broke.

Income Down—Outgo Up

About this time expenses both in the east and at the mine had reached a point unknown in the old days, and to make matters worse the mint and smelter returns for some time had not been sufficient to pay the regular dividend. The surplus was exhausted, so the eastern office sent a letter of inquiry as to why expenses had increased and receipts diminished. The manager referred it to the finance committee, which recommended that they dispense with the ditch tender and the old pensioner who swept out the bunk houses and brought in wood for the men and the cook. The men could bring in their own wood; likewise the cook; and the cook's helper could clean up the office. It was recommended that development work should be stopped.

They then interviewed the mill foreman as to why the mint and smelter returns were not up to the mark. He said "Get the mine foreman and assayer and I will show you the trouble." They all went up to the ore bin and dumped an average car from the mine. He began picking out slate broken from the footwall. There was 400 lb. in that one-ton car. This all contained pyrite. Neither the pyrite nor the slate contained gold, but the iron got into the concentrates. Then the manager asked an explanation. The mine foreman said, "When your superintendent took charge the ore ran around $18 and concentrates $100. Now the ore runs $14 and concentrates $80; but we used to mine the

ore clean. Your new superintendent orders us to put in much deeper holes and use more powder. This shatters the footwall, and much of it is so fine that we cannot sort it out, and while we break more tons to the man, it is tonnage that we don't want." The manager made no change, but wrote the New York office that the grade of the ore had fallen and that expenses had been reduced to the lowest possible point. So the secretary sent notices to stockholders that they very much regretted that circumstances had arisen making it necessary to reduce the dividend 50 per cent until things took a turn for the better.

Appointment of a Receiver

This caused the two original western owners to go up and look over the property and they gathered a lot of evidence and then applied to the court for a receiver. The judge heard all the evidence on both sides and then appointed Henry, the old superintendent, as receiver.

The General Manager vigorously defended his administration and said he had given the mine the best of management along the lines on which he had been trained. He did not see why he should be criticized for compelling everyone to live up to the letter of his contract, and that he had never in all his training observed any departmental heads that could use their own judgment, in defiance of rules. He admitted that many of his men were dissatisfied and that he was not getting the best results, and he had heard rumors that his sending men away hungry who came out to look for work caused a lot of talk, but still he could not find any precedent in his experience for giving away the company's food. He could not see why the company should give prospectors free meals. He added that these men generally were presumptuous. In fact, one of them had walked into the office and said, "Hello, have you got any papers or magazines to spare?" "Naturally I sent him about his business," explained the manager.

Excessive Red Tape

The old judge made a few remarks: "Young man, your training has been along the lines of doing things in the most roundabout way, regardless of cost, and when your committees, boards, or bureaus ran out of money they had ways to get more which mining companies do not have. Another thing which you have overlooked is consideration for other people. No man in this world is big enough to ignore people as you have made it a practice of doing. Traveling men have told me that your answers to them are almost invariably discourteous. I have heard a lot about your methods. The foundry man told me your inspector rejected forty mine-car wheels because they were one thirty-second of an inch out of round. A teamster told me that he contracted to deliver a carload of freight in a certain time and while hauling the last load he killed a horse and was one day late in his delivery, and you held up his money and finally settled by penalizing him 10 per cent. The evidence shows your freight charges are almost double those under Henry's management. You advertise for bids and your teamsters have a load only one way, while Henry paid on a per-ton basis for incoming freight and always had a load of concentrates to send back. You piled your concentrates and advertised for their transportation separately. This was called to your attention by a teamster, and he says you told him you had laid down certain rules and you did not care to receive any suggestions.

"In regard to your various committees, I would say from what I have heard that you should have had only one and called it the 'Circumlocution Committee.' We call your methods 'Passing the Buck' and I have heard that one unregenerate wag has named your property the 'Buck Passer Mine.'

"Now, as to the old prospectors who used to drop around, it is always customary to give them a meal and a loaf of bread or two. This is not charity. It is in a way their right, and any operating mine always makes them feel welcome. All mines are at first prospects, and before they can be prospects there must be a prospector, and these men stand a lot of hardship. In fact, an old prospector once told me that his ideas of a good time was to sit up at a lunch counter and order a steak and see someone else cook it and have the price in his pocket."

The receivership did not appeal favorably to the eastern people, so they had a conference of the stockholders at the mine. The eastern men were shown how things had been run, and the four original owners took the reins in hand, closed the New York Office, reinstated the old superintendent and left the shaping of the company's policy in the hands of the original western owners. Things are now back to normal and common sense instead of nonsense is again in the saddle.

Treatment of Native-Copper Tailing by the Calumet & Hecla

According to the report of the Calumet & Hecla Mining Co. for 1922 there was a decided increase in the tonnage treated in the tailing reclamation plant during the year, owing to a supply of finer material and to plant changes. The average daily capacity was over 5,000 tons. The following metallurgical data is presented:

Reclamation Plants

	Regrinding Plant — From Mine	Regrinding Plant — From Old Sand Tailing
Tons treated	340,340	489,150
Assay mill headings, per cent copper	0.765	0.647
Assay tailings	0.503	0.434
Refined copper produced per ton treated, lb.	5.16	4.17
Cost per pound, excluding smelting and selling, cents	5.22	8.62
	Ammonia Leaching Plant	Flotation Plants
Tons treated	1,353,654	498,540
Assay headings, per cent copper	0.488	0.520
Assay tailings	0.108	0.179
Pounds refined copper per ton treated	7.72	6.95
Cost per pound copper, excluding smelting and selling, cents	3.86	2.67

In the regrinding plants, sand is tabled after being ground in Hardinge mills. Sand table tailings go to the ammonia leaching plant, all slime being treated by flotation in Minerals Separation machines. The copper present in the ore is in the metallic state.

Fluorspar Mining Depends Upon Steel Industry

The producers of about 70 per cent of the basic open-hearth steel made in the United States in 1922 reported that they consumed 72,962 short tons of fluorspar and had stocks on hand amounting to 45,637 short tons on Jan. 1, 1923. If the steel companies which did not report consumed a like proportion of fluorspar, the figures given indicate a total consumption in all steel plants of about 104,000 tons in 1922 and total stocks of about 65,000 tons on hand Jan. 1, 1923. The steel industry, according to the U. S. Geological Survey, took about 86 per cent of the spar shipped from the mines during the year. A total of 33,108 tons was imported during 1923.

Effect of Increasing Depth of Hole in Stoping

Results of a Study Made with Different Steels by United Verde Copper Co.

By H. W. Seamon

Mine Efficiency Engineer, United Verde Copper Co.

THE following data were obtained during tests made by the United Verde Copper Co. to determine the comparative drilling speed of several kinds of steel and the relation between the length of hole and the tonnage broken per drill shift:

The length of hole that can be drilled with the steel in use at this property is 9 ft. with the 1¼-in. round, the gage of the starter being 1⅞ in. and the finisher 1⅝ in., or ⅛ in. greater than the diameter of the steel. With the ⅞-in. quarter octagon steel, used for stopers and jackhammers, the limiting diameter is 1⅛ in., permitting the use of 1¼-in. gage, or even 1 3/16 in., for the finishers, with a corresponding length of 12 ft. Holes of this length have been drilled in massive sulphide ground with the ⅞-in. steel, using a No. 248 machine equipped with anvil block chuck, and should be practicable in the schist and porphyry orebodies.

Experiments with a No. 26 machine (Ingersoll-Rand) showed that the use of the anvil block chuck decreased the drilling speed about 6 per cent. With the purpose of avoiding the use of the anvil block, and to cut down on the weight of the steel, some long finishers were made up from the ⅞-in. quarter octagon, with the 1¼-in. round Leyner shank. At first an attempt was made to weld this shank on to the quarter octagon, but with little success. Later the shank was formed on the steel by repeated heating and forging. The relative breakage of the different steels is shown in Table I.

Table I—Relative Breakage of Different Steels

Steel	Shank	Number of Pieces Tested	Average Net Running Time
1¼-in. Rd.	Leyner shank	2	28 min.
⅞-in. Oct.	Leyner shank welded	5	4½ min.
⅞-in. Oct.	Leyner shank formed	5	16 min.
⅞-in. Oct.	Plain shank	4	22 min.

The second and third classes of steel, shown above, all broke at the point where the round shank and the square steel joined. The other two generally broke at a point midway between the shank and the bit. These tests were made with a No. 248 machine, with a 1-in. hose, and air pressure at 85 lb. The drill holes were plugged with broken steel to slow down the drilling speed and to permit the use of a piece of steel until it broke, without stopping the machine. The conditions were abnormal, inasmuch as there was no penetration of the drill bit.

Table II shows, in short form, the relative drilling speed of the four types of steel tested:

Table II—Relative Drilling Speed of Four Types of Steel

Machine	Chuck	Steel	Shank	Drilling Speed In. per Min.	Drilling Speed Per Cent
No. 248	Plain	1¼ in.	Leyner	6.8	100
No. 248	Plain	⅞ in.	Leyner	6.3	93
No. 248	Anvil block	⅞ in.	Plain	5.9	87
No. 248	Plain	⅞ in.	Plain	6.4	94

From the above it would seem that there is a decrease in drilling speed, when the ⅞-in. steel is used in a large machine, amounting to about 7 per cent. Apparently this is caused by the greater vibration of the steel. In addition to this, there is a further decrease of about the same percentage due to the use of the anvil block.

Some experiments were made in one of the company's stopes with different lengths of hole, and with both round and quarter octagon steel. These results are shown in Table III, listed according to the length of hole and kind of steel. The stope was measured after each round, and from the advance and the data at hand the other factors were calculated.

Table III—Results of Drilling Different Lengths of Hole

Drill Shifts To the Round	Average Depth of Hole	Average per Shift: Hours Drilling	Holes	Footage	Sets	Footage per Set	Tons per Shift	Tons per Foot	Tons per Hole
With 1¼ in. Round Steel and ¾-in. Hose									
2	5.0	4:15	7.0	35	1.10	32.2	30.0	0.86	4.3(1)
4	5.1	5:26	9.0	46	1.44	25.4	39.0	1.07	4.3(1)
4	5.0	5:06	8.25	41	1.65	25.0	45.0	1.09	5.5(1)
2	6.0	4:50	6.0	36	1.12	32.0	30.5	0.85	5.1(1)
5	6.0	4:30	8.2	49	1.44	34.1	39.4	0.80	4.8(1)
4	6.1	5:15	9.0	55	1.65	33.4	45.0	0.82	5.0(1)
3	7.4	5:10	9.0	67	2.07	32.3	54.0	0.85	6.0(2)
4	7.65	5:41	10.25	78	2.47	31.7	67.5	0.86	6.6(2)
4	8.0	4:58	9.25	74	2.65	28.9	72.5	0.98	7.8(2)
With ⅞-in. quarter octagon steel and anvil block chuck and ¾-in. hose									
3	7.1	4:40	9.0	57	2.23	25.5	61.0	1.07	6.8(3)
5	7.15	5:28	9.2	66	2.34	28.0	63.9	0.97	6.9(3)
6	7.17	5:35	8.5	61	2.10	29.1	57.3	0.94	6.7(3)
3	7.4	4:46	7.67	57	1.90	29.8	52.0	0.92	6.8(3)
6	7.83	5:12	9.5	74	2.63	28.3	71.7	0.96	7.5(3)
5	8.8	5:24	8.8	77	2.68	28.9	73.0	0.94	8.3(3)
With ⅞-in. steel and 1-in. hose									
2	7.15	4:36	10.5	75	2.50	30.0	68.3	0.91	6.5(4)
6	7.25	4:40	10.0	72½	2.42	30.0	66.0	0.91	6.6(4)
4	8.34	4:06	8.25	69	2.44	28.2	66.5	0.96	8.1(4)
Averages									
(1)	5.53	4:54	8.2	45	1.40	32.2	38.2	0.85	4.66
(2)	7.72	5:16	9.55	74	2.42	30.4	66.2	0.90	6.94
(3)	7.53	5:13	8.85	66½	2.31	28.8	63.1	0.95	7.15
(4)	7.55	4:27	9.5	72	2.45	29.3	66.8	0.93	7.05

From the data in Table III we may assume the following to be generally true:

As the length of hole increases:

1. The drilling time increases, due to the fact that fewer set-ups are necessary in the average stope round.
2. The drill footage increases, for the same reason.
3. The sets broken and tonnage per shift increase, due to the greater footage.
4. The footage per set and, conversely, the tonnage per foot drilled, remains approximately constant, with equal spacing of the holes.
5. The tonnage per hole increases as the length of hole.
6. The use of 1-in. hose in this case increased the footage per shift 8.3 per cent, and the tonnage 5.5 per cent. This was done with a decrease in gross drilling time of 17 per cent.

The steel breakage on this work was as follows:

	Per Cent
¼-in. round (estimated)	1.43
⅞-in. quarter octagon, ¾-in. hose	3.47
⅞-in. quarter octagon, 1-in. hose	3.48

The data were collected with some care, and show what has been done in one stope, under average conditions, over a period of three months' time. The results are indicative of what may be expected in general stoping work regardless of the class of ore.

Output of Abrasives in 1922

The output of grindstones and pulpstones in the United States in 1922 amounted to 26,524 short tons, valued at $1,020,186, according to figures reported by the producers to the Geological Survey. These figures show an increase of less than 1 per cent in quantity and a decrease of 17 per cent in value. The grindstones produced amounted to 21,367 short tons, valued at $574,900, an increase of 31 per cent in quantity and 20 per cent in value.

New Books

Engineering and Literature

English and Engineering. Edited by Frank Aydelotte. McGraw-Hill Book Co., New York. Price, $2.

This, as the subtitle states, is "a volume of essays for English classes in engineering schools." It is the second edition of a book prepared in 1917 by a Rhodes scholar who is now the president of Swarthmore College. Professor Aydelotte is an American Oxonian and is true to form in his purpose of placing emphasis on the connection between engineering and literature. The book contains a number of excerpts from the writings of various men, including such recognized masters of style as Huxley and Stevenson, and such modern exponents of engineering as George S. Morison and John L. Harrington. The diverse essays are made congruous by illustrating the editor's idea that "the function of English in technical education is twofold: in the first place, to train students to express themselves in writing and speaking . . .; in the second, to furnish something of the liberal, humanizing, and broadening element which is more and more felt to be a necessary part of an engineering education."

Professor Aydelotte's introduction is an earnest plea for the cultural side of an engineer's training. "The engineer must deal with men as well as with machines. He must be able to think and to express himself in terms that other men will understand." Again: "The engineer must think in terms of civilization, in human terms as well as material, or be a traitor to his opportunities." This idea of linking the teaching of English—even of technical writing—with the cultural side of the engineer's training has been advocated, and put in practice, by several other educators, notably Prof. John Erskine, of Columbia University, and Prof. P. B. McDonald, of New York University. The idea as stated by Professor Erskine, is that "the emotional substance of literature must become a personal and conscious possession of the reader before the discussion of technique can be profitable."

The book contains examples of the best writing on the philosophic aspects of scientific progress; it is a delightful compendium apart from its basic purpose, which it will subserve by inciting the young engineer to read more literature of the same character. "To lay a foundation for the understanding of the relation of literature and science is one of the first requisites of that training which aims to educate engineers that they may be 'not only expert in science but reverent toward life.'" It seems to me that the editor of this book is doing a good work, and with prospects of success. More than once I also have advised my younger brethren to seek good intellectual company and to acquire mental culture by reading Huxley, Ruskin, Tyndall, and others from whom the editor of this collection has taken his examples not only of good writing but of stimulating philosophy. Such reading is needed continually to correct the debauching effect of the ordinary newspaper and magazine. Professor Aydelotte in this book does not try to teach his readers how to write; he endeavors to excite the desire to write well, by showing how it has been done, and how it bears upon the art of engineering. How is one to learn how to write well? In a recent issue of *The International Interpreter* I find this reply: "By writing incessantly, by pruning incessantly, by studying masters of prose with whom we are in sympathy, by remembering that good writing comes from direct observation, systematic thought, and having something to say." To write without thinking is to try to sail without a breeze, or, as Professor Aydelotte says: "There is no profitable treatment of words that is not also a treatment of ideas. . . . It is impossible to give a student any real power over language until he comes to regard language as a means for the expression of thought, and to realize that the thought is the important thing. No student (nor any other person) ought to write unless he has something to say and a strong desire to say it."

Most of the poor writings, like most of the poor speeches, are vitiated at the start by the lack of these requisites—in short, the keynote of good writing is sincerity. That necessary quality is clearly manifest in Professor Aydelotte's effort to inculcate right ideas on the subject. It is a pleasure to commend this book to the young engineer—and to any older ones that are willing to learn.

T. A. RICKARD.

A New Edition of Low's Ore Analysis

Technical Methods of Ore Analysis. By A. H. Low, 9th ed., John Wiley & Sons, New York. Price, $3.50.

Notes on Technical Methods of Ore Analysis. By A. H. Low. John Wiley & Sons, New York. Price, $1.75.

To the technical chemist, the ninth edition of Professor's Low's book needs no introduction, previous editions of the work having become standard reference books in most of the metallurgical laboratories in America and abroad. However, the present edition has many new features that add greatly to its value both as a reference work and as a textbook in teaching the subject of quantitative analytical chemistry. Dr. Low's long academic experience has led him to the conclusion that the average student in rapid metallurgical analysis fails to "observe, read, think and manipulate carefully," with the natural result that even though he may obtain the correct "answer," he has probably failed entirely to grasp the significance of the various steps which he has taken in arriving at this result. For this reason, in the present edition of his book, the author has added numerous explanatory notes to the various methods described. In order that these notes may not prove a source of annoyance to the trained technical chemist, they are brought together at the end of the method and are referred to at the proper place in the description.

As a further aid to the teaching and study of the subject, there has been incorporated a chapter on Remarks to Instructors and a chapter addressed to students, giving representative examples of what the author has called his "Step Demonstration Method" of teaching the subject. These latter sections of the book precede and are entirely separated from the main portions, and consequently those who may wish to use the book solely as a reference will find that the academic character of the book does not obtrude unduly.

As in previous editions, the descriptions of the methods are given in great detail, very little being left to the judgment of the operator. Too often the beginner, as well as the experienced analyst, sees possible short-cuts or modifications in a given method, which modifications usually prove to be quite valueless, often leading to serious error. Professor Low's methods are all tested and proved and will give accurate results under the conditions given, so that technical operators and students would do well to follow his directions exactly.

Many of the methods appearing in previous editions have been retained without alteration; some have been revised and modified and some have been rejected altogether. In addition, many new methods have been incorporated, among which may be mentioned the author's own method for the determination of oil, gas and sulphate of ammonia in oil shale. New to his work also are Frank's modification of Edinger's method for determining sulphur in oils and the sulphur-dioxide method for determination of copper minerals in oxidized ores. Among other new methods are those for determination of cadmium, chromium, fluorine, mercury, molybdenum, nickel and cobalt.

A companion to the above volume is "Notes on Technical Methods of Ore Analysis," by the same author. In this small book the author gives more complete details of his Step Demonstration Method of teaching quantitative chemical analysis. This method has been devised by Professor Low after many years of teaching experience, during which time many other methods had been tried with more or less unsatisfactory results.

Briefly, the method consists in dividing a method of analysis into several definite steps, each step being demonstrated by the instructor and performed by the student before proceeding to the next step. Lectures follow the practical demonstration, and in this way the student is induced to take a much more lively interest in his work. With his interest so maintained he will naturally make more rapid strides in his studies. The method is well worth close study by both teacher and student.

R. M. COLEMAN.

SOCIETIES, ADDRESSES, AND REPORTS

Northwest Miners Meet in Spokane

The Northwest Mining Association held its annual convention in Spokane last week from May 21 to 25. Many interesting papers and addresses were on the program, including "What Mining Means to Montana," by C. A. Towne, publicity director of the Anaconda company; "The Revival of Mining," by Dean L. O. Howard of Washington State College; "The Silver Situation," by Dean F. A. Thomson of the University of Idaho; "Recent Improvements in Flotation," by A. W. Fahrenwald, of the U. S. Bureau of Mines; "The Metal Mining Outlook in Idaho," by Stewart Campbell, mine inspector for Idaho; "Congressional Legislation," by Ravenel Macbeth, secretary of the Idaho Mining Association; "Mineral Resources of the Baker District," by Warren D. Smith, of the University of Oregon; "The Cornucopia District," by R. M. Betts; "Blue-Sky Legislation," by J. F. Callbreath, secretary of the American Mining Congress; and "Prospecting," by Dr. R. W. Meldrum, of Spokane University.

Balbach Company Entertains for Edmund D. Fisher

Archibald R. Watson, president of the Balbach Smelting & Refining Co., entertained a large company of men prominent in finance, metallurgy, and professional life at the Metropolitan Club, New York, recently, in honor of Edmund D. Fisher, president of the Hamilton National Bank.

Feiker to Make Raw Material Survey

At the request of Secretary Hoover, of the U. S. Department of Commerce, F. M. Feiker, Assistant to the President of the McGraw-Hill Company, Inc., has again been granted leave of absence to undertake the organization and general direction of the world surveys of raw material supplies, rubber, sisal hemp, nitrates, for which Congress recently made an emergency appropriation of $500,000.

Mr. Feiker served as Assistant to the Secretary of Commerce during the first year of Mr. Hoover's administration, acting as general assistant in organizing the personnel and industrial trade contact committees in relation to the Bureau of Census, the Bureau of Standards, and the Bureau of Foreign and Domestic Commerce. Out of his nine months' work came the monthly statistical survey of the Bureau of Census, the Division of Simplified Practice of the Bureau of Standards, Commerce Reports in new form, and fifteen so-called commodity divisions of the Bureau of Foreign and Domestic Commerce.

Engineers Discuss Position in Public Affairs

Rear Admiral J. K. Robinson, chief engineer of the Navy, and Frank B. Jewett, president of the American Institute of Electrical Engineers, were the chief speakers at a joint meeting of engineering groups recently held in the Engineering Societies Building, New York, to discuss "The Engineer in Public Affairs." Both eulogized the engineer as a dominantly creative force in civilization. Gano Dunn, president of the J. G. White Engineering Corporation, who presided, urged the need of organized effort by engineers.

New Mexico School of Mines Confers Twenty-five Degrees

The annual commencement of the New Mexico School of Mines, of Socorro, took place May 17 and 18. One advanced degree and twenty-four bachelor of science degrees were conferred. Dr. Montagu Butler, of the University of Arizona, delivered the commencement address. Following the dedication of memorial campus gateposts of red sandstone, an Alumni Association of the New Mexico School of Mines was organized.

University of Iowa Offers Summer Courses

The University of Iowa has issued a bulletin (No. 253) descriptive of its summer courses in geology and geography, which extend from June 11 to Aug. 25. Residence courses will be given at the University at Iowa City, and field courses at Baraboo, Wis., in the Black Hills of South Dakota, and in Iowa.

Utah Engineers Meet

The Utah Society of Engineers held its annual banquet on the evening of May 23 in Salt Lake City, at the Newhouse Hotel. The chief business of the evening was the election of officers for the coming year, who were chosen as follows: H. C. Lewis, president; Ernest Gayford, vice-president; J. A. Hale, secretary; R. K. Brown, treasurer, and L. D. Anderson, member of executive committee. The annual reports were followed by a general discussion. The speaker of the evening was H. A. Strauss, who spoke on the resources of Utah. About thirty were present at the banquet.

International Mining Exposition in Salt Lake in 1925?

The Mining Committee of the Salt Lake City Chamber of Commerce is interesting itself in the project of holding an international mining exposition in Salt Lake City in 1925. Governor Mabey, who, with Senator King and Congressman E. O. Leatherwood, was present at a meeting of the committee, expressed himself in favor of such a plan, and the committee unanimously indorsed a letter prepared by Governor Mabey to send to the business men of the state. Governor Mabey called attention in his letter not only to the importance of Utah as a mining state, and to the fitness of Salt Lake City for the holding of such an exhibit, as a mining center, but spoke also of the close proximity of the city to places of great scenic interest, such as the Yellowstone Park, Zion Park, Bryce Canyon, the Grand Canyon of the Colorado, Royal Gorge, and Great Salt Lake. An exposition committee, consisting of K. C. Goodrich, Charles Peter, Joseph Wirthlin, and George M. Watson, has been formed, and the committee is prepared to act as soon as definite information has been received as to the attitude of Utah business men toward such a project.

American Mining Congress Plans Two Western Meetings

The American Mining Congress has issued an illustrated announcement of the twenty-sixth annual meeting of that organization, to be held at Milwaukee Sept. 24 to 29. Open forum discussions of equipment problems will be the special feature of the convention. Other topics for discussion include Industrial Co-operation, Selective Immigration, Dangerous Paternalism, Intelligent Conservation, Wise Taxation, and Standardization.

The exhibits of mining machinery which have featured previous meetings will again be provided, about 150 having been arranged for, so that operating men will find much of interest as well as executives. Reduced railroad rates can be obtained.

On June 13 and 14 a mining conference will be held in Sacramento, Calif., in conjunction with the two-day session of the board of governors of the western division of the American Mining Congress. J. F. Callbreath will speak, and a tour of the Mother Lode section will be made. Endeavors will be made to collect authentic data on western mining districts for presentation to eastern capitalists.

MEN YOU SHOULD KNOW ABOUT

E. B. Thornhill has removed from Hurley, N. M., to Ocean Beach, Calif.

W. F. Koslowsky has left London for Transylvania on mine examination work.

H. W. Turner is examining lime deposits for cement companies in California.

J. A. Carpenter has established an office at 718 Hibernian Building, Los Angeles, Calif.

Bradley Stoughton has been appointed professor of metallurgy at Lehigh University.

C. A. Banks, managing director of B. C. Silver Mines, is in Vancouver on business for the company.

F. L. Sizer, of San Francisco, is engaged in mine examination in Nevada and Sierra counties, Calif.

Hamilton M. Brush, vice-president of the American Smelting & Refining Co., has returned from Europe.

Thomas Riggs, formerly Governor of Alaska, is now vice-president of the Continental Mines, at Kirkland Lake, Ont.

Colonel D. C. Jackling has been elected president of the Utah Copper Co. and the Bingham & Garfield R.R. Co.

A. Wende, general manager of the Wright-Hargreaves mine, Kirkland Lake, is in charge of operations on the Sylvanite mine.

E. G. Riebe, of Seattle, has made an examination of the Silver Bell property, across the Bear River from Stewart, for Seattle interests.

E. G. Germer, president of the Colonial Mines, Cobalt, which is now controlled by the Continental, has been visiting the property.

R. W. Stone, Assistant State Geologist of Pennsylvania, is investigating the occurrence of molding sands in northwestern Pennsylvania.

Palmer J. Cook, formerly in charge of the Midas mine, at Valdez, Alaska, is now superintendent for the Granby company, at Maple Bay, B. C.

Dr. Ellsworth Huntington, of Yale, will represent that university at the Pan-Pacific Scientific Congress to be held in Australia this summer.

Senator Tasker L. Oddie, of Nevada, will be one of the speakers at the ceremonies incident to the dedication of the Zero Milestone Monument in Washington on June 4.

H. De Witt Smith, general superintendent of the United Verde Copper Co., Jerome, Ariz., visited the *Journal-Press* office last week. He will remain in New York during most of June.

The San Francisco Section of the A.I.M.E. gave a dinner on May 23 to **Charles G. Yale,** who recently retired from active service with the U. S. Geological Survey.

Alford Roos, of Bayard, N. M., consulting geologist for the Mineral Mining & Milling Corporation, is on a reconnaissance into a new district in the San Andreas Mountains.

S. R. Elliott, Ishpeming, Mich., general superintendent of the Cleveland-Cliffs Iron Co., made a tour of inspection of his company's properties on the Mesabi iron range last week.

R. M. Henderson, general manager of the Wellington Mines Co. at Breckenridge, Colo., left Denver May 22, with the president of the company, on a scouting expedition to Nevada.

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The Duke of Manchester
Prospecting Lake Montigny region of Quebec for gold

The **Duke of Manchester,** accompanied by his daughter, Lady Mary Montagu, is reported to be in the timber lands on Lake Montigny, Quebec, of which he owns 6,000 acres, prospecting for gold.

Temple Jackson, of Miami, Ariz., formerly auditor of the Tonopah Belmont Development Co. and at present accountant for the Miami Copper Co., has been admitted to the bar.

Cyril W. Knight, associate provincial geologist Ontario Department of Mines, will complete his work this summer in the investigation of underground developments in Cobalt and South Lorrain.

Henry Wyman, who has been acting as general manager of the Calumet & Sonora Mining Co. at Cananea, Sonora, is leaving for Cedral, S. L. P., and **D. B. McAllister** is now acting in his place.

Rance Patterson, one of the oldest prospectors of the Silver City district, in New Mexico, has just sold his claims, and is departing for his boyhood home in Arkansas to enjoy the fruits of a lifelong anticipation.

A. G. Burrows, assistant provincial geologist, Ontario Department of Mines, will resume in the coming season his studies of the Porcupine gold area in connection with rock structures as revealed underground.

W. H. Blackburn has been appointed superintendent of local operations of the Tonopah-Ajax Mining Co. at Cripple Creek, in place of **H. W. Stotesbury,** effective June 1. Mr. Stotesbury is transferred to California.

H. C. Blegen, president of the Porcupine Mountain Oil & Gas Co., Ltd., formerly largely interested in the Montana and other American oil fields, has started drilling operations in the Porcupine Mountain district of Manitoba.

Thomas Graham, general superintendent of the Canadian Collieries (D), Ltd., was elected chairman of the British Columbia Division of the Canadian Institute of Mining and Metallurgy at the annual meeting held on May 14 at Vancouver.

Dorsey A. Lyon and **Thomas T. Read,** assistant director and supervising engineer respectively of the U. S. Bureau of Mines, were recent visitors on the Mesabi iron range, were they were guests of several of the engineering societies, besides inspecting many of the properties.

Walter W. Bradley, who has been associated with the California State Mining Bureau for eleven years, has been promoted to the position of deputy state mineralogist. Mr. Bradley was statistician for the Bureau and has contributed a number of bulletins to its publications.

W. J. Olcott, president of the Oliver Iron Mining Co., and **Samuel B. Sheldon,** vice-president of the Minnesota Steel Co., are attending the meeting of the presidents of the subsidiary companies of the United States Steel Corporation, and also will attend the meeting of the American Iron and Steel Institute.

OBITUARY

Dr. Hans Goldschmidt, inventor of the Thermit process, died suddenly in Baden-Baden, Germany, on May 20,

John Henry Clemes, for many years a representative of English mining interests in various parts of the world, died recently in Newquay, Cornwall, in his seventy-fourth year.

Theron Geddes, in former years a resident of Salt Lake City and part owner of the Swansea mine, at Eureka, recently died at Ocean Park, in California, at the age of seventy years.

J. D. Shilling, general superintendent of mines for the Utah Copper Co., died at Bingham, Utah, on May 23. Mr. Shilling was sixty-eight years old, and had been in the employ of the Utah Copper Co. since 1906.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

TONOPAH mine managers declare that completion of Pittman Act silver purchases will not force them to suspend operation of their properties in Nevada.

Granby Consolidated has closed a transaction whereby the Copper Mountain mine and Allenby concentrator are acquired.

The old Valencia mine, at Guanajuato, Mexico, is to be reopened.

In British Columbia, the Premier company has started a new adit to tap the ore 500 ft. below the present workings.

The Freeport Sulphur Co. has brought its new plant for the treatment of Hoskins Mound sulphur to 1,000 tons' daily capacity.

The Oliver Iron Mining Co. has won one more victory in its fight to move part of the town of Hibbing, Minn.

A bill introduced in the Canadian Commons aims to authorize the Dome Mines Co. to split its stock.

Bisbee, Ariz., will promote championship drilling and mucking contests to celebrate the "Fourth."

The Calumet & Hecla company is completing its 81st level haulageway, in Michigan.

Copper mines in Shasta County, Calif., will probably be reopened.

In southeast Missouri, the Annapolis Lead Co. plans to add a new 500-ton unit to its concentrator.

The Franklin Mining Co. will resume operations in the Michigan copper country.

Tonopah, Nev., Is Not Anticipating an Early Death

Rumors Denied That Completion of Pittman Act Silver Purchases Will Shut Down Mines

The completion of Pittman Act silver purchases will not finish Tonopah, Nev., as a productive district. Although output at the present time is limited only by mill capacity, this does not by any means indicate that the Tonopah mines are cleaning up available ore in preparation for cessation of operations when silver purchases under the Pittman Act are completed. In fact, officials of both the Tonopah Mining Co. and the Belmont company, which mines have by far the largest production record in the district, have stated that these two mines can and will operate after the period of dollar silver is over. These statements by Charles R. Miller, vice-president of the Tonopah Mining Co., and by Frederick Bradshaw, general manager of the Tonopah Belmont Development Co., should put an end to rumors that these two companies would be forced to suspend operations as soon as the price of domestic silver dropped to foreign quotations. Several of the mines have substantial ore reserves of good grade, and most of the smaller companies will undoubtedly continue as formerly. In a district like Tonopah, where production is not limited to one vein, but where there are many profitable veins, new and important developments occur from time to time which give apparently worked out mines new "leases on life." At present more development work is being performed outside the proven ore zone than at any time in the history of the district, to the north and west in the Tonopah Extension and Montana Tonopah Reorganized, to the south and west in the West End, Tonopah "76," and MacNamara Crescent, and to the east in the Halifax and Belmont.

Deluge of Pittman Act Silver—Mint Director Calls Halt

On Tuesday, May 29, the Director of the Mint at Washington announced that no further tenders of Pittman Act silver would be accepted until a careful check of all purchases has been made. Tenders for future delivery will be received and filed until June 15, however. During the week ended May 26, 5,034,107 oz. was tendered, making 197,512,629 in all. On the two following days more than enough was received to complete the purchases, if the stand of the Director with respect to the revocation of allocations for subsidiary coinage is maintained.

Aluminum Operations Flourish in Arkansas and Illinois

The East St. Louis plant of the Aluminum Ore Co., a subsidiary of the Aluminum Company of America, is running at capacity, output equaling peak production of 1918 and 1920. The company is utilizing its entire plant, including part built during the war, and 2,000 men are now employed, 300 more than at first of year. The mines of the company at Bauxite, Ark., are likewise operating at near capacity to supply raw material to the reduction plants.

Mexican Government Studies High Smelting Charges

Old Story: Smelters Wax Fat, Miners Starve, According to the Latter—Freight Rates Investigated

The Mexican Department of Mining, at Mexico City, through its inspectors of mines, is investigating the situation of the smelting companies which have established plants throughout the republic with liberal aid of the government. Mine producers contend that the earnings of these companies are unreasonably high.

Many of the richest mines are situated in remote districts, far from railroad communications, making it difficult and expensive to transport machinery and supplies to them. As a consequence, few of these regions have smelters or mills for treating the ores.

The national government, fully realizing the importance of the mining industry, has lent aid to the establishment of smelting plants by authorizing liberal concessions. Principally among them are three smelters at Monterey and one each at Asarco, Torreon, Saltillo, Mazapil, Boleo, Teziutlan, San Luis Potosi, Chihuahua, and Cananea.

There is a general complaint on the part of shippers that the treatment charges are too high, and the government is being urged to compel the smelters to give better terms. They believe that the railroads should reduce the freight on ores in order to stimulate the mining industry. These points and others are to be studied by the Department of Mining with a view of stimulating mining to the utmost.

Granby Closes Deal for Allenby Concentrator and Copper Mountain Mine

New Property Well Equipped—Mill and Railway Require Some Overhauling—Jackling and Heckscher New Directors

By Robert Dunn

THE directors of the Granby Consolidated Mining, Smelting & Power Co. have ratified the plan for the acquisition and 90 per cent ownership of the Allenby Copper Co., until recently known as the Canada Copper Corporation. D. C. Jackling, August Heckscher, W. H. Coverdale, and H. G. Moulton were elected directors of Granby. C. H. Munroe, general manager of the Granby company, will take immediate steps toward putting the Allenby properties into operation. The property includes the Copper Mountain mine and surface plant, a railway, and the Allenby concentrator. The enterprise requires but the touch of power to become productive.

The railway up the mountain to the mine will need some repairing, and some readjustments will be required in the 2,000-ton mill, but the mine, with its reported 10,000,000 tons of 1.74 per cent copper ore, wants nothing more than miners and operating executives.

Allenby, the newest copper camp in British Columbia, was named after the British general who walked into Jerusalem at the head of his troops a few years ago. Situated four miles south of Princeton, B. C., on the Copper Mountain branch of the Kettle Valley Ry., it is connected by steel both with the mine and with the outside.

For months Allenby, upon the building of which the Canada Copper Corporation expended $1,300,000, has been tomblike. Active work here began in 1918 when the country round about was a wilderness. Roads were constructed, a sawmill was erected, fifty-five houses were built, and water, electric light, and other facilities were provided before erection of the mill was begun in November of that year.

The concentrator building measures 320 x 207 ft. with an average height of 45 ft. Sampling is automatic, by electric power governed by a master clock. The plant is equipped to reduce the ore to pass 80 mesh. Much of it, however, will be fine enough to pass a 200-mesh screen. Oil flotation will be used, the concentrate from which will go to the Trail smelter, of the Canadian Consolidated Mining & Smelting Co. This announcement was made officially some weeks ago.

Owing to the distance from large manufacturing centers, it was necessary, in the construction of this mill, to build and equip complete machine, electrical, and carpenter shops. A large part of the equipment was made on the ground. For instance, ore cars, of steel construction, were manufactured at the plant.

A large pumping plant had to be provided, as 1,100 gal. of water are needed for every ton of ore treated. Three centrifugal pumps were installed, two to be in constant use, with the third in reserve. Taking power from electric motors, each pump handles 800 gal. of water per minute from the Similkameen River. The pumps discharge into a 14-in. pipe line, which, in traveling 5,000 ft., raises the water 600 ft. to twin storage tanks above the concentrator. An auxiliary pump raises the water still higher to a "fire" tank.

About $2,500,000 has been spent at the mine in development, construction, and equipment work. The ore is a chalcopyrite and bornite disseminated through the granodiorite. It occurs in large lenses, some of which outcrop. In prospecting, several miles of trenches were dug through the surface detritus. Diamond drilling then was undertaken, followed by the driving of tunnels, laterals, raises, and a shaft to prepare the ore for extraction and delivery to the railroad. There is a 7½ mile haul to the concentrator.

There are three tunnels; the lowest extends straight into the mountain 2,900 ft., placing 1,100 ft. of ore above it. It measures 10 x 12 ft. inside the timbers. Such drill holes as are bottomed in ore show the ore at that level to be similar in character and grade to that nearer the surface. This gives encouragement that large additional tonnages will be found when prospecting begins below the haulage tunnel.

In addition to the fifty-five houses at Allenby, there was built a modern bunk house equipped with steam heat, electric lights, shower baths, and sanitary conveniences. At the mine camp, beautifully situated in the timber, with an outlook across the valley of the Similkameen, there are two large modern bunk houses and a boarding house large enough to seat 300 men at a time. The former are steam heated, with hot and cold running water, and lockers. There also are forty cottages, as well as a large compressor plant, shops, and warehouses.

Allenby concentrator, just acquired by the Granby Consolidated

Butte & Superior Must Pay Tax on $2,917,372.93

Amount Represents Value of Ore Extracted From Elm Orlu Property Involved in Litigation

The Supreme Court of Montana has reversed the decision of the District Court of Silver Bow County which sustained the action of the State Board of Equalization of Montana when it allowed the Butte & Superior Mining Co. to deduct $2,917,372.93 in calculating the net proceeds of its operations to determine its tax for the year 1920. This amount represents the value of the ore which the Butte & Superior company paid for when the suit between that company and Senator Clark's Elm Orlu Mining Co. was compromised in 1919.

The State Board of Equalization authorized the Butte & Superior company to deduct the amount named, on the ground that it represented "cost of ores purchased." Silver Bow County, in which the mine is situated, contested this ruling, and on this contest the case was carried to the courts. The Butte & Superior company contended that taxes had been paid "by mistake" during a period of several years prior to the settlement of the case. After stating that the law will not permit a taxpayer to correct mistakes in this way, the decision says, "As we view the facts recited in the affidavit, the question of who shall or shall not pay taxes on the net proceeds of the ores taken from the Elm Orlu mine is not in any way involved in this proceeding."

Hoskins Mound Mines Produce 1,000 Tons of Sulphur Daily

Texas Property Leased to Freeport Co. Is Equipped With New $2,500,000 Plant—6,000,000 Tons Developed

Charles E. Herrmann, vice-president of the Texas Co., says that the sulphur output of the new mines at Hoskins Mound, Texas, has reached as high as 1,000 tons per day, the estimated capacity of the plant which is nearing completion. Operations are conducted by the Freeport Sulphur Co.

Some years ago the Texas Co., while drilling for oil at Hoskins Mound, in Brazoria County, Texas, encountered rich strata of sulphur at depths ranging from 800 to 1,500 ft. Wells were drilled to prove at least 6,000,000 tons of recoverable sulphur. This is the minimum, according to engineers who were employed to study and report upon the matter. The limits of the mine have not been determined by drilling on all sides. The Texas Co., having no charter power or desire to engage in the sulphur business, on March 14, 1922, entered into an agreement with the Freeport Sulphur Co. for the development of Hoskins Mound. The sulphur company agreed to construct at its own expense a plant with all auxiliaries and facilities for the extraction of sulphur, and to diligently market the product of this property. By the terms of this agreement The Texas Co. is to receive an amount corresponding to 50 per cent of the net profits until the sulphur company out of the remaining 50 per cent has realized the amount of its plant investment with interest at 6 per cent per annum, and thereafter an amount corresponding to 70 per cent of the net profits. The sulphur company entered into stipulation that not less than one-half of the sulphur marketed by it or any of its affiliated companies during any fiscal period shall be of sulphur from Hoskins Mound, provided such quality is available there. The sulphur company immediately obtained an extension of the Houston & Brazoe Valley R.R. to the mound. A plant costing something over $2,500,000 was built.

The Freeport Sulphur Co. has had years of experience in producing and marketing sulphur, and has excellent marketing connections, both domestic and foreign. Large foreign consumption and good prices abroad are expected, in view of the marketing arrangements that have been made.

Premier Starts New Tunnel to Tap Ore 500 Ft. Lower

New Quarters Erected—Larger Mill Rumored—Plenty of Low-Grade Ore

The Premier Gold Mining Co., British Columbia, has started a crosscut tunnel from a point near the international boundary, at Thirteen-mile, which is designed to cut the main Premier vein at 2,400 ft. from its portal and at a depth of about 1,200 ft. below the outcrop. This is 500 ft. below the present bottom level. Incidentally, the tunnel will explore at depth another vein, to the southwest of the main vein, which has been found on the surface and has been tapped at varying depths by a diamond drill. The tunnel evidently is being driven primarily as a main haulage tunnel, rather than as a prospecting tunnel, as its sectional size is 8 by 10 ft.

The company has begun the construction of a new 100-room boarding house and will start work soon on a six-suite apartment house with three-room suites. This is for the married members of the staff, and it will have attached to it a tennis ground for their entertainment.

It is rumored that a large concentrator is to be built at the mouth of the new tunnel, and though no official announcement has been made, there is reason to believe that the rumor is well founded. Diamond drilling has demonstrated that the ore in the main vein below the present bottom level, though considerably wider than in the upper workings, is of only milling grade, and the existing concentrator is already treating 50 per cent more ore than it was designed for.

Successors of Old-Time "Double-Jack Artists" Will Contest at Bisbee

Machine Men and Muckers Will Drill and Shovel for Prizes on July 4

Many have deplored the passing of the "double-jack artists," and old-timers like to tell of bygone days when the ability to use the hammer often brought handsome rewards in the shape of prizes for the best drillers.

Bisbee, Ariz., will not permit the passing of this "sporting" side of mining, and plans have been made public for a modern drilling contest that is to be held at Warren Park on July 4. Not only the machine men, but the muckers as well, will have an opportunity to display their skill and share in the distribution of cash.

There are to be two main events—namely, a drilling contest, in which the man who drills the deepest hole in ten minutes wins first money, and a mucking contest, where the contestants will strive to muck out equal-sized bins in the shortest time. Prizes for the machine men will be $200, $100, and $50 for the first three. The mucker's rewards will be $100, $50, and $25. Wet plugger machines will be used, and the rules stipulate that the weight of the machine used must not exceed 51 lb. Holes must be drilled horizontal; a variation from the horizontal of 2 in. to the foot will disqualify the entrant. The hole must be at least 1⅞ in. in diameter, and, if more than one hole is drilled, the first one must be not less than 7 ft. deep. The men will start from standing position, with plugger in hand, and must connect the air hose to the machine after the signal to go has been given. The muckers will use any kind of shovel they choose, and the material shoveled will be clean limestone crushed to pass a 3-in. ring.

Calumet & Hecla's Underground Railroad Nears Completion

Eighty-first Level Haulageway Will Cut Mining Cost—To Be 1½ Miles Long Exclusive of Side Tracks

One of the most interesting ventures in deep mining ever conceived is that entered upon by the Calumet & Hecla Mining Co., in Michigan; the time is nearing when it will become of actual use. The project is a haulageway, a mile and a half long, at a depth of 8,100 ft., connecting all of the conglomerate lode shafts from the South Hecla branch to the Red Jacket shaft.

The driving of the haulage level is practically completed, and attention will soon be directed to its equipment, much of the material for which is on the ground. The haulageway was designed to solve the problem of deep mining, as operations below the 81st level will be carried on from this depth instead of from surface. Eventually, all rock from the conglomerate will be handled from the tunnel instead of through the various shafts. With the gradual abandonment of intervening shafts, rock will be hoisted exclusively through the Red Jacket shaft, one of the world's deepest, extending vertically 4,920 ft. into the earth, and No. 12, South Hecla shaft, will be used for the lowering of supplies and men.

No. 5 Tamarack probably will be used as the feedwire compartment for the haulageway. All other shafts on the conglomerate will be closed as they are mined out. This will effect notable economies, for it will do away with separate hoisting equipment, shaft equipment, surface plants, and railroad switch lines. In the haulageway will be laid a network of tracks, and it probably will be the only "railroad system" in the world operated at such a depth. Each shaft will have an outlet at the haulageway by means of crosscuts driven to each compartment.

A great volume of rich rock still remains to be mined in several of the conglomerate shafts above the 81st level. This tonnage is in shaft pillars, in backs of stopes, and in arches. Some of the vein matter runs exceptionally high in copper content, particularly in upper levels, in which the yield in the early days of the property was 75 to 80 lb. per ton. The equipment to be installed in the haulage tunnel will be electrically driven. Electric power will operate locomotives, compressors, skips and pumps.

Broken Hill 10, in Australia, May Close Down

By Cable from Reuters to "Engineering and Mining Journal-Press"

Melbourne, May 24. The half-yearly report to March 31 of Broken Hill Block 10, Ltd., in announcing a loss of £50,000, states that unless lead prices quickly improve the mine may again be compelled to shut down. It was inoperative for a long period recently as a consequence of labor troubles and low prices for the product.

Valenciana Mine, at Guanajuato, Mexico, to Be Reopened

Old Workings, Unwatered, Will Yield Stope Filling and Virgin Ore—Air Lift Used

The Guanajuato Reduction & Mines Co., of Guanajuato, Mexico, is treating about 600 metric tons of ore at its Bustos mill and Flores plant, and about 200 tons per day at its San Pedro Xilmonene plant. The company has recently decided to unwater and open up a large part of the famous Valenciana mine, the most important piece of development work that has been undertaken for many years. The Valenciana mine was in the past the largest producer in the camp, its output up to 1890 being estimated at 300,000,000 pesos, probably equivalent to nearly the same figures in United States dollars as most of this was extracted when silver was high in price and the Mexican peso was equal in value to the American dollar.

Since 1891 the little work that has been done has been confined to the upper levels. The company now owning the property acquired it in 1904, and since then the water level has been gradually lowered. This has been effected by the drainage of adjacent mines and by baling through the Guadalupe shaft; the water level is now about 250 m. below the collar of the main shaft, known as the Tiro General. This shaft is the deepest of the old-time shafts in the camp, about 500 m. from the collar to the bottom level. The shaft is lined with masonry for 100 ft. below the octagonal collar.

In the old days eight whims were operated. The shaft is 29 ft. in diameter across the flat of the octagon. There are only two levels opened up from this shaft, one at 385 m. and the other at 500 m. The upper will be opened first. According to the old plans, the level is about 800 m. in length, 600 m. being to the north and 200 to the south of the shaft, with extensive workings along the whole length. Henry P. Smith, general manager, proposes to carry out the work of unwatering the shaft in the following manner:

An old steam hoist is being remodeled into an electric hoist driven by a 107-hp. motor. At the level where the water now stands, or 250 m. from the collar of the shaft, a pump station and a small sump will be cut. A Goulds two-speed mine pump, driven by a 85-hp. motor, will be installed. The water from the shaft will be lifted into the sump by an air lift, for the purpose of which a 700 ft. two-stage air compressor will be installed at surface. The air lift will give no trouble, as there will be ample submergence. The amount of water will be regulated by the man attending the pump. The water and air pipes, as well as the air-lift line, as the water is lowered in the shaft, will be hung down the shaft from iron brackets, set into the side of the shaft at four-pipe-length intervals. This way of placing a pipe column down an untimbered shaft was tried some years ago in the Rayas shaft of the same company with entire success, the column being perfectly rigid and never giving trouble. Water will also be baled out, balers having a capacity of two tons being proposed.

It is estimated that about fourteen months will be needed in which to complete the unwatering. Large fills and blocks of ore in place are expected above the 385-m. level. The old fills from the upper levels of the mine worked through another shaft have consistently been of good grade. Ore hoisted through the Tiro General will be transported to the Bustos mill by a cableway.

Bill in Canadian Commons Would Permit Dome Stock Distribution

A bill is now going through the Dominion Parliament in Canada which will amend the Companies' Act to provide that mines and other companies with wasting assets may pay dividends out of operating revenue although the value of the net assets be thereby reduced below the par value of the issued capital stock, and which will relieve directors from liability in respect to such dividend payments. This bill was introduced at the request of the Dome Mines Co. in order to permit that company to proceed with its announced plan of splitting up the stock, giving four shares of no par value for each present share of $10 par. It is understood that the passage of the bill is practically assured.

Imported Flint Pebbles Not Displaced in Michigan Copper Mills

Although importation of flint pebbles from France and Denmark for use in fine grinding of rock has practically been abandoned, according to the Structural Materials Research Laboratory of Lewis Institute, Chicago, flint pebbles continue in use in the Michigan copper district. Calumet & Hecla uses pebbles exclusively in finer grinding operations, having found no satisfactory substitute. Though steel is used in the ball or tube mills in the original grinding, pebbles are employed in the regrinding of tailing. Calumet & Hecla carries a large stock of these, sufficient to last for several years. All pebbles are imported, none having been found in this country or continent to equal the Danish flint in hardness. Calumet & Hecla has demonstrated through long usage and tests that the imported flint pebbles give better service in every way than steel balls.

Will Hunt Diamonds in Guiana

William Stewart, of Paris, Ontario, has organized a party of nineteen to go on a diamond searching expedition into the interior of British Guiana. The party were to sail on May 25 from Halifax, N. S., for Georgetown, Demerara, and thence by motor boat up the Essequibo River. Mr. Stewart has spent three years in British Guiana and is confident of the richness of the diamond field.

Hibbing Must Move to Permit Mining of Iron Ore

Minnesota Town Loses Another Round in Court Battle With Oliver Company—Appeal Follows

Another chapter in the removal of a portion of the village of Hibbing for the purpose of permitting the Oliver Iron Mining Co. to mine the underlying ore, which has been in litigation for two years, has been written by the decision of Judge W. A. Cant of the district court in which he ordered the village of Hibbing to vacate the streets and alleys. The decision further disallows any general or special damages to any of the property owners or business men in the two adjacent forty-acre tracts of the original townsite, but the question as to damages to be awarded to the village, if it can be shown that the village is entitled to such, was left for later decision.

Recently the U. S. Supreme Court refused an injunction sought by property owners, to forbid the removal of certain buildings and improvements on the north sub-division. The mining company petitioned the district court for an order for the vacation of the streets and alleys on the north forty-acre tract on which all surface rights had been acquired and from which the buildings had been moved. This petition was based on a refusal of the village council to vacate the streets and alleys after several propositions seeking for a settlement had been considered. The tonnage of ore involved underlying the tract in question and in the banks on the three sides is approximately 18,000,000 tons of ore representing several millions of dollars. Notice of appeal was entered by the attorneys representing the property owners.

Bounty for Canadian Copper Producers

The budget just presented by Minister Fielding in the Canadian Parliament at Ottowa lends a helping hand to copper producers. A bounty is provided of 1½c. per pound on copper manufactured in Canada from Canadian ores, into bars and rods. After the first year, however, the bounty is to be reduced each year and will expire June 30, 1928.

This is intended to assist the Trail metallurgical works of the Canadian Consolidated Mining & Smelting Co. Objection already is made that the five-year period in which the bounty will be in force, is altogether too brief to enable Canada to establish firmly a copper fabricating industry. Some of the nickel-copper producers might develop business in bars and rods. On the other hand, the budget provides for a drawback of 99 per cent on copper in blocks, pigs, or bars when used in the manufacture of rods for electric wires. How far that will negative the other concession to Canadian copper manufactured in Canada remains to be seen.

News from Washington

By PAUL WOOTON
Special Correspondent

Commerce Department Collects Data on Foreign Silver Situation

Gold-Silver Commission Will Study Use of Silver for Coinage by Various Countries

As a result of a questionnaire sent to commercial attachés and consuls in the principle countries, the Department of Commerce has the latest available comprehensive data covering the silver situation in those countries. From that collection of basic information, Secretary Hoover has been requested by the Senate Commission of Gold and Silver Inquiry to supply data as follows:

I. Use of silver as metallic reserve for note issue.

(a) To what extent is silver used as metallic reserve? What proportion of the entire metallic reserve may be silver?

(b) At what value is the silver reserve taken? The value of the coin or the bullion value at date of acquisition or as revised from time to time.

(c) In case silver constitutes part of the metallic reserve, under what conditions it is ever paid out in the redemption of notes?

(d) What changes, if any, have occurred since 1914, in the laws or practices governing the use of silver as reserve for notes?

II. Use of silver as currency.

(a) Give résumé of present law governing the coinage of silver and state what changes, if any, have occurred since 1914. What is the weight and fineness of silver in each coin?

(b) What limit, if any, is placed upon the amount of silver which the government may purchase or which may be coined at the public mints?

(c) To what extent was silver withdrawn from circulation during the war? Was this withdrawal at government's request and to increase metallic reserve for notes or was it the result of melting down and export because of its very high bullion value? Was any embargo placed on the export of silver?

(d) What substitutes, if any, were used for silver coin withdrawn from circulation? What was the attitude of the public towards such substitutes?

(e) To what extent has silver been restored to circulation and what is the plan of the government with respect to complete restoration? Has there been any change in the content or fineness of silver coins?

(f) Has there been any serious agitation of the adoption of bimetallism or free silver standard? What is the opinion of finance minister as to advisability of using silver as currency?

(g) Has there been any change in the attitude of the public towards the use of silver?

III. Statistics of silver reserve and silver currency.

(a) Total reserve of central bank (or banks) of issue, classified by character of cover (gold, silver, foreign exchange, etc.) by months or by quarterly periods, Jan. 1, 1914, to July 1, 1922, or later.

(b) Total face value of silver coins in circulation, by months or by quarterly periods, Jan. 1, 1914, to July 1, 1922, or later.

(c) Imports and exports of silver (bullion and coin) by years, 1914 to 1921 and for first six months of 1922.

The commission is continuing its investigation of the mint's subsidiary currency allocations. The accounts are being gone over by experienced auditors so that the exact amount involved in the allocations which the commission will challenge may be known.

Invitations to the convention to be held in Reno, at which the organization of the Silver Export Association will be discussed, are to be issued by the Commission of Gold and Silver Inquiry, as such. The commission's act empowers it to deal directly with foreign corporations and producers. Invitations will be sent to the leading producers of silver in Canada and in Latin America.

War Minerals Rulings

John Briar, the War Minerals Relief Commissioner, has recommended, and the Secretary of the Interior has approved, the following disallowances: Henry Lockhart, Sr., Socorro Manganese Co., manganese, not within the act; Fanny Barrett Mining & Milling Co., manganese, right to further award not established; the Long Chance Mining Co., tungsten, net loss not established; Thomas L. McCarty & Co., manganese, not within the act; O. B. Pancost, tungsten, stimulation not established; William A. Ewing, manganese, not within the act; Willow Creek Rare Metals Mining Co., tungsten, commercial importance not established.

Awards have been approved as follows: Johnson and Bermont, tungsten, $692.45; Charles R. Moser, manganese, $470; Edmund Edwards, chrome, $540.

Australia and Alaska Among Destinations of Survey Geologists

T. W. Vaughan, of the geologic branch of the U. S. Geological Survey, is en route to the Pacific Coast. Mr. Vaughan and H. E. Gregory have been appointed delegates to the Pan-Pacific Scientific Congress to be held in Melbourne and Sydney from Aug. 13 to Sept. 3. Other Survey geologists are engaged as follows: J. D. Northrop is examining prospecting permits and leases in the Rifle and Rangely districts of Colorado, and will be absent from Washington until Aug. 1. A. J. Collier is examining possible oil structures between Great Falls and Kevin, Mont. F. C. Schrader is examining certain mines near Boise, Idaho, for the Department of Justice. W. C. Alden is continuing his studies of the glacial geology and physiography of the northern Great Plains region, starting at Great Falls, Mont., and working thence west and south through Yellowstone Park and Big Horn Basin, Wyoming.

J. D. Sears and W. H. Bradley are at Rock Springs, Wyo., where they will be joined by J. E. Reeside. Thence they will continue stratigraphic work in Moffat County, Colo. W. S. W. Kew will spend the first two weeks of June in examining reported deposits of oil shale in the vicinity of Medford, Ore. Sidney Paige will sail from Seattle for Nome, Alaska, on June 5, in charge of three parties, which will make geologic and topographic surveys of Naval Petroleum Reserve No. 4, on the Arctic coast of Alaska.

Zinc Producers and Galvanizers Must Co-operate, Thinks Bain

The steps taken at the St. Louis meeting of the American Zinc Institute looking to closer co-operation with the galvanizers are regarded by H. Foster Bain, the director of the U. S. Bureau of Mines, as one of the most important outcomes of the meeting. Heretofore the galvanizers have believed that the zinc industry has had little concern for their problems. Now that the Zinc Institute has taken the initiative looking to close co-operation, it is believed that much can be accomplished toward overcoming difficulties which are harmful, alike to the zinc industry and to the galvanizers. Each is interested, Mr. Bain believes, in improving the quality of galvanized sheets.

Since the change from iron to steel, galvanized sheets have gradually lost much of the good reputation they once had, Mr. Bain points out. This is due to the fact that a different and a more difficult technical process must be employed. He believes the technology in galvanizing steel sheets can be brought to the same plane of efficiency as was obtained with the use of iron sheets. By the production of a better product, it will be possible, he believes, greatly to increase the domestic market for zinc.

Court Denies Vogelstein Claims for Extra Allowance on Copper

The decree of the Court of Claims denying additional compensation from the United States to L. Vogelstein & Co., Inc., for copper sold to the government during the war, was sustained by the United States Supreme Court May 21 in an opinion read by Associate Justice Butler.

Between Sept. 28, 1917, and Feb. 1, 1918, the United States bought from Vogelstein & Co. 12,542,857 lb. of copper at 23½c. per lb. The company subsequently asked $424,196 additional, being 3.38c. per lb. above the 23½c. price, as just compensation.

The Court of Claims found, and the Supreme Court affirmed, that 23½c. per lb. was the market price, having been fixed by the War Industries Board.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Rhodesian Congo Border Hopes To Find New Copper Deposits—Nigerian Tin Company Incorporates

BY W. A. DOMAN

London, May 17—A few weeks ago I mentioned that A. Chester Beatty was interested in a large mining undertaking in Rhodesia. This is the Rhodesian Congo Border Concession, which has a territory about the size of England. The company has a monopoly from the British South Africa Co., to prospect for minerals for five years, and the right to mark out any mining claims in that area. The geology is stated to be identical with that of Katanga. It is hoped and believed that large copper deposits will be found, as the Katanga deposits seem to continue to Bwana M'Kubwa and N'Kana—i.e., right through the concession.

Minerals Separation, Ltd., is largely interested in consequence of a discovery of new methods for treating oxides, silicates, and carbonate of copper. In fact, Minerals Separation hopes to do with its process for Rhodesian copper what the cyanide process did for Rand gold ores, and what flotation is doing for sulphide copper ores in North America. F. K. Horner, the consulting engineer, was formerly general manager of the Union Minière du Haut Katanga, and Raymond Brooks, also from the Union Minière, is on the engineering staff.

Despite the slump in the price of the metal, new tin-mining companies are being formed to operate in Nigeria. The latest is Batura Monguna Tin, with a nominal capital of £150,000 in 4s. shares. There are twenty-three tin properties in all, covering 92 square miles. The area is said to be one of the last remaining properties with small overburden over rich wash and commanded by water. Subsidiary companies are to be formed. A. W. Hooke, formerly manager of the Bisichi Co., is appointed general manager, and will report direct to the board, and Laws, Rumbold & Co. are the consulting engineers.

Two important finance companies have issued their annual reports this week—the Consolidated Mines Selection, and the Central Mining and Invesment Corporation. The former is now, more or less, a holding company, having disposed last year of its South African share holdings to the Anglo-American Corporation of South Africa. The total income for last year was £84,184, against £69,154 twelve months earlier. The company does not intend to remain quiescent, as it is understood to be considering properties that have been submitted to it in other parts of the world.

The Central Mining Corporation made a net profit last year of £528,029, in comparison with £314,357 for 1921, due largely to the sale at high prices of some of its Kafir holdings. For the whole year a dividend of 12s. is paid, plus a bonus of 4s. a share. The whole of the company's holding in the Rhodesia Broken Hill Development Co. has been disposed of since Dec. 31 last. The corporation has taken a substantial interest in the banking firm of Bernhard Scholle & Co. and has also acquired important interests in oil concessions in Venezuela.

According to rumor, the Akim (West African) company is about to float a subsidiary. Although official details are not obtainable, it is said the capital will be in the neighborhood of £1,000,000, and that 250,000 fully paid £1 shares will go to the Akim company as purchase price. An issue of 50,000 shares for working capital at 35s. is to be made. This would seem to indicate that the report recently made on the quartz reefs was of a satisfactory nature, though its full tenor has not yet been made public.

Brisbane Letter

Two Companies Mine Lead Ore at Indooroopilly—Concentrator Nearing Completion

By Special Correspondence

Brisbane, April 24.—Although the metropolitan district is not developing into a mining region of pronounced importance, as was predicted by sanguine enthusiasts when silver-lead ore was discovered at the Brisbane suburb of Indooroopilly three years ago, there are indications that the mining of this ore, albeit on a small scale, has come to stay. The position of the silver-lead holdings is being improved by the good price ruling for lead.

The Finney's Hill United, the parent and chief company operating at Indooroopilly, has nearly completed the installation of a crushing and concentrating plant for treating its own ore, and in the meantime is holding its crushing material (which had previously been shipped south) for treatment on the spot. It is the intention to reduce the ore to a high-grade concentrate and send that product to the Port Pirie works of the Broken Hill company in South Australia. An adjoining mine, owned by Silver-Lead, Ltd., which has been working on a shoot of rich ore which outcropped on the original find higher up Finney's Hill, has let the operative part of its lease on tribute for twelve months. The tributers are now engaged in deepening an old shaft to enable them to work the lode from overhead and also in erecting a plant of their own for crushing and concentrating the ore.

A third mine is being worked a short distance to the eastward of the two older leases, but so far nothing definite has been decided here except the difficulty of locating the Indooroopilly orebodies. These are the only three silver-lead holdings that remain operative of the larger number of mining leases, running into hundreds, which were taken up two or three years ago—several of them on the faith of "diviners."

Montreal Letter

London Enthuses Over Prospects and "Near" Prospects in Ontario and Quebec

BY ALEXANDER GRAY

Montreal, May 24—Canadian owners of mining properties and prospects—differentiation being made between those where a certain amount of development has been done and those merely having surface showings, or located in the vicinity of something of promise—are not averse to London responses to appeals for capital. They welcome what is going on, even if some of it be injudicious. So long as London is open-eyed and willing to take sporting chances, the disposition is to be accommodating.

An outstanding example of London receptivity is the advent of the Duke of Manchester, who says a philanthropic Greek virtually "made a gift" to him of about 6,000 acres in the Harricana district of Quebec. According to the duke, the area he and his noble party are about to explore is not many miles "away from the Hattie and the Hollinger."

It is to be explained that the reference to the Hattie—which is approximately forty miles, as the crow flies, from the Hollinger and twice that distance or more from the Harricana section—is due to the fact that the Greek who practically made "a gift" of about six square miles to the duke is the chief owner of the Hattie. The duke, therefore, is out of focus—his bracketing of the three H's is defective—but there is fish and game where he is going—and if there be gold, as well, the romance will be the more replete. Amos, on the Transcontinental Railway, is where the ducal party will launch its expedition. They are grateful to the Greek—at present. The Lake De Montigny district, in which they intend to operate, is seventy miles east of the Quebec-Ontario border; the Hattie is almost forty miles west of the inter-provincial border, so neighborly amenities need not be disturbed.

The Manchester mining estate is going to have a lusty rival if London undertakes to test several hundred square miles of Labrador placer country, as seems likely. A Montreal company, that really found placer gold in Labrador, proposed to sell an interest to London, $1,000,000 being the sum mentioned as a first consideration. Promoters were modest in all other respects. They refrained from palpable misrepresentation such as caused Dr. Ledoux to complain of the misuse of his name. If they could not obtain a million dollars, they compromised by

accepting $50,000 for proving purposes, London entering into an undertaking to underwrite securities of a larger company later on, if the placers are sufficiently extensive and the average is payable. Meanwhile the action of Dr. Ledoux is exposing those who claimed to have had his certificate that 25 lb. of gravel yielded 5 oz., rather upset another Labrador company that had been leasing fractions of claims on a you-give-us-$200-and-we-will-do-the-rest basis.

If all the London deals spoken of are consummated, Canada will undergo extensive exploitation from coast to coast. The views of Mr. Curle regarding northern Ontario seem to have brought about a movement of an impetuous character. The association of Mr. Joel with a proposal to purchase control of Hollinger was somewhat of a *ballon d'essai* for the benefit of those who enlisted the National Mining and New Consolidated Gold Fields in the flotation of the Rochester Veteran and other claims at Porcupine. At least that is the opinion of Hollinger directors, publicly expressed. As a consequence, the new issue has been soaring in the London market, at a rate that evokes admiration among speculators.

Instead of aloofness, as shown during the last fourteen years, since Porcupine was discovered, London has become precipitous. Mr. Joel is not joining in this. He is a matter-of-fact magnate with a sense of humor. When he glanced through the documents bearing upon Porcupine ground undergoing flotation, and had consulted persons familiar with the situation, his naïve comment was:

"There seems to be nothing but gold."

San Francisco Letter

Shasta County Copper Mines Will Resume—Plumas Belt Active

By Our Special Correspondent.

San Francisco, May 21—The situation in copper mining in Shasta County affords interest. Four large mines, the Iron Mountain mine of the Mountain Copper Co., the Mammoth mine of the U. S. Smelting company, the Bully Hill mine of the Shasta Zinc & Copper Co., and the Afterthought mine, are at present closed down. All of the properties have ore reserves. Recently the Mountain Copper Co., after four years' shutdown, has started preparations to rehabilitate its property. This will require about three months. When the property is in operation 200 miners will be required. The company has been employing 150 men at its Hornet mine and has been steadily shipping 400 to 500 tons of pyrite daily to the San Francisco Bay region. A new boarding house, as well as a well-equipped change house, has been recently completed at the Hornet mine. The Mammoth mine has been down for several years, but recently the situation has been investigated by the company officials with a view to resumption. No official announcement of resumption has been made, but the company has looked into the labor situation as a preliminary. Two hundred men will be required, and it will be difficult to get them.

The Shasta Zinc & Copper Co. has succeeded in perfecting a process for treating its zinc-copper ore and can market its zinc-oxide product on the coast. When additional capital has been secured, this property will be no doubt started up again. The Afterthought mine and the smelter at Ingot will be sold at public auction June 7, 1923. The minimum price has been set at $902,619. Thus it appears probable that at least three of the four copper properties will resume operations during the year.

In Plumas County both the Engels and the Walker are operating steadily and with excellent results. The Calaveras Copper Co. has completed its construction campaign and will resume operations in the immediate future. Six copper properties may therefore be expected to be in operation during the summer.

At a recent hearing of the Industrial Accident Commission, the question of interconnecting the Kennedy and Argonaut mines, apparently settled at a former hearing by both companies agreeing upon the maintenance of the existing connection between the two mines on the 3,650 level of the Kennedy, was reopened, and additional connections at lower levels are being asked for by the Argonaut. The Kennedy officials had agreed to pay half the cost of maintaining the 3,650-ft. connection. Another hearing must be held to settle the question. The bill introduced by the Industrial Accident Commission providing for interconnecting mines has apparently died with the passing of the legislative session. This leaves the question of interconnecting mines to be settled in individual cases, which meets with the approval of most mining men.

BRITISH COLUMBIA

Six Groups, Neighboring Premier, Consolidate

James Hawthornthwaite and A. H. McCallum have organized the Stewart Consolidated Gold Mines, Ltd., with a capital of $3,000,000, and have consolidated into one block about fifty claims to the east of the Premier mine property and extending over the Bear River ridge into Bear River valley. The consolidation includes the following groups of claims: I. X. L., Rocks of Ages, Dalhousie, Grey Copper, Argyle, and International. It is stated by McCallum and Hawthornthwaite, who are on the ground, that not less than $100,000 will be spent in exploration during the present summer.

Ingenika River District Attracts Prospectors

The Consolidated Mining & Smelting Co. has acquired a group of five claims on the Ingenika River, a tributary of the Finlay River, as the upper reaches of the Peace River is called. The district at the present time is quite inaccessible so far as the transportation of ore is concerned; but it is said to contain extensive deposits of a good grade of copper ore. Anaconda Copper company engineers are in the district.

ONTARIO

Significant Ore Discovery at Cobalt

At the 925 level of the Colonial shaft, in Cobalt, high-grade ore has been encountered, and the property now gives the appearance of being another producer. The new discovery is important on account of the fact that this is the deepest level in Cobalt at which commercial ore has been found. Both the Beaver and Temiskaming have deeper shafts, and although on the Beaver a vein carrying some silver was encountered at 1,200 ft., the ore was not found in commercial quantities. The Colonial appears to be operating on the extension of one of the O'Brien veins, although it is believed that the main vein has not yet been encountered. This latest discovery gives further promise that the life of the camp may be considerably augmented by discoveries made on the lower Keewatin diabase contact. Development of this horizon, however, is expensive, and as the veins rarely persist through from the lower to the upper contact of the diabase, deep exploration is hazardous. The Violet property, north of the Colonial, operated by the La Rose, has again started production, and is shipping mill ore to the Mining Corporation plant for treatment.

Sabotage Discussed in Labor Meeting

The recent strike vote taken in Porcupine did not amount to much, and a comparatively small number of the men voted. It was stated at a meeting by a labor agitator that while no strike would be declared, the men would strike on the job—i.e., give less work for a day's pay. Another meeting to discuss the labor situation has been called, but operators in the camp believe that the possibilities of a strike are slim. At present the McIntyre has more men on its payroll than ever before in the history of the company. Production in the camp is being maintained, and during the month of May the Dome produced at an average rate of $15,000 a day.

CALIFORNIA

Diamond Drill Imperial Lode Mine

The satisfactory market for lead has stimulated further development at the Imperial Lode mine, southwest of Lavic station, on the Santa Fe railroad in San Barnadino County. Diamond drilling operations under the direction of S. H. Ingram, superintendent, are being conducted. A force of twelve men is employed.

Work Clay Mines

The clay beds in the vicinity of Ione are being investigated. A variety of excellent clays are available, four companies being engaged in mining from the area.

NEVADA

Betty O'Neal Finds New Ore

The Betty O'Neal Mines Co., operating near Battle Mountain, paid its second dividend of 15c. per share on May 15. Actual production began in November, 1922, and to date two dividends, aggregating $115,800, have been paid. Mine developments are satisfactory, and new orebodies are being opened, some of which contain high-grade ore. The orebody developed on what is known as No. 4 tunnel level, 150 ft. above the shaft collar, has been drifted on for over 800 ft. and raised on at regular intervals, the raises connecting to the No. 3 tunnel level, which is about 190 ft. on the slope of the vein above the No. 4 tunnel. The shaft is 336 ft. deep and at this depth is connected to the main haulage and drainage tunnel. The vein between No. 4 tunnel and the main haulage tunnel, about 750 ft. on its dip, is practically undeveloped, and is regarded as a promising block of ground.

Hilltop Plant Operation

The 100-ton flotation plant of the Hilltop Nevada Mining Co. at Hilltop, near Battle Mountain, started operating on May 12. The mill was completed some time ago, but operation was delayed due to slow progress in driving the long raise between the transportation tunnel and the upper or Burns tunnel, practically all of the developed ore being above the Burns tunnel.

ARIZONA

Verde Central Busy at 1,000 Ft.

Plans for development at the Verde Central Copper Co.'s mine, one of the "new" mines of the Jerome district, call for the construction of a large pump station, sumps, and loading pocket at the 1,000 level. Preparations are being made to complete this work as soon as possible, so as to facilitate the driving of crosscuts on this level that will prospect ore that was recently discovered on the 800 level. The shaft, sump, and other excavations at the 1,000 level have disclosed additional mineral showings that will warrant investigation. The main effort, however, will be directed to the intersection of the downward extension of the 800 level ore. The Calumet & Arizona Co. is interested in the Verde Central and is aiding in conducting the developments now under way.

Old Pueblo Lessees Quit

Uncertainty of the future of the silver market has caused the Old Pueblo Leasing Co., which has been operating the State of Maine property, near Tombstone, to discontinue work and dispose of its equipment. This company, which was financed mostly by Tucson people, secured a lease on the old mine and dump early last year and successfully handled that material and ore sorted from "gob" taken from old workings. This dump was the largest one in the Tombstone district and it is reputed to have yielded good returns to the owners of the lease.

Quicksilver Claims Will Be Developed

The Porterie Mercury Mining Co. has been organized for the purpose of developing deposits of cinnabar which are located in the Winfred mining district, about 10 miles northeast of Phoenix. Theo. Davis, of Phoenix, is president and manager of the company. A permit to sell stock was granted the company last month and plans for financing the concern are maturing. The property consists of eight full claims that were originally located by J. A. Porterie and Henry A. Porterie, of Phoenix. The mine is easily accessible from Phoenix, and it is planned to start developments at once.

COLORADO

Buena Vista-Romley Branch Probably Will Be Abandoned

The Colorado & Southern Ry. Co. on May 15 filed an application with the Interstate Commerce Commission for the reopening of the case wherein the railway company asked authority to abandon and junk the branch line of road extending from Buena Vista to Romley. This branch serves what was once an active mining district, which at present, and for several years past, has had only one or two small operating properties.

In September, 1921, the railroad company applied for permission to abandon the road. The application was resisted by the Colorado Metal Mining Association and the County Commissioners of Chaffee County. In July, 1922, the Interstate Commerce Commission filed its decision, which in part stated:

"Upon the facts presented we are unable to find that the present and future public convenience and necessity permit the abandonment of the branch line of railroad in question. If the improvement in operating results, confidently anticipated by protestants, should not materialize within a reasonable period of time, the applicant may renew its application. It is not in the public interest that even a strong line like the applicant should permanently operate parts of its system that do not yield revenues sufficient to pay operating expenses and interest on the net scrap value of the property. Persons directly interested in the continued operation of the line should co-operate to the fullest extent possible with the management of the road with the view of effecting more favorable operating results. The offer of the applicant to lease the line proposed to be abandoned to protestants at a rental of $5 per year should be given serious consideration by protestants."

Contending that there have been no improvements and that the operating results of this line, which have been filed with this commission, show conclusively that there is no public necessity for the further operation of said branch line, and that there is no hope of any improvement in conditions on said line, the railroad company asks that it be permitted to abandon the operation of its line of railroad known as the Buena Vista-Romley branch, and take up and move all its property therefrom.

MONTANA

Goldsmith Shaft Will Be Sunk

H. E. Clements, of Salt Lake City, has been made manager for the Crystal Copper Co., in the Butte district. The Goldsmith mine, which is in Walkerville, is the most important property owned by the company. It is one of the best of the small mines in the district. At present eighty men are employed, with a payroll of $2,600 per week. The gross value of ore produced per month is approximately $30,000. The present plans of the company are to sink the shaft farther and develop at depth. The mine produces high-grade silver ore.

Charmer Shuts Down

The Charmer mine, one of the youngest silver mines in the district, has been shut down. This property adjoins the Nettie mine of the Anaconda company, which is one of the largest silver producers in the country. Although the Charmer is only 200 ft. deep, it has disclosed some large, promising veins. General manager Anderson refuses to make any statement relative to the shutdown other than to say that machinery would be left intact. Twenty men were laid off.

Gagnon Consolidated Financed

A group of Spokane mining men has agreed to finance the Gagnon Consolidated company, which owns property 5½ miles south of Butte. It is planned to sink the present 120 ft. shaft to the 200 level. From this level crosscuts will be driven to cut the veins exposed in the shaft. Ore has been shipped from the shaft that assayed 10.2 oz. silver, $21.60 gold and 16.2 per cent lead per ton. This is the only work being carried on in this part of the Butte district.

Barnes King Will Abandon Shannon Mine

An operating loss of $15,224 is shown in the report of the Barnes King Development Co. for the quarter ending March 31, 1923. Receipts for the three months were $31,915, of which $30,574 was from the Shannon mine, near Marysville. There was 3,200 tons of ore treated in the Gloster mill, with a bullion value of $22,963.64. An additional amount of $7,584.21 was received from 1922 operations. Due to the unfavorable showing of the recent extensive development work done in the Shannon mine, it was decided to abandon this property as soon as some known pillars of ore have been removed.

Suit Against Davis-Daly Dismissed

On motions of attorneys for the plaintiffs, the suit for an accounting instituted some time ago by Daniel F. Dillinger and David F. Roach against the Davis-Daly Copper Co. was on May 15 ordered dismissed without prejudice in the federal court. The plaintiffs wanted an accounting, permission to examine the books, records and contracts of the Davis-Daly company and the Smokehouse Mining Co. and an injunction perpetually restraining the Davis-Daly from mining in the Smokehouse ground.

UTAH

Silver King Coalition Shipped 10,483 Tons in First Quarter

The Silver King Coalition, according to a statement made at the annual stockholders' meeting, during 1922 shipped ore and concentrates which yielded returns of $1,425,401. Net earnings for the year were, after depreciation and tax reserve, $687,312, and the surplus at the end of the year amounted to $508,276. More ore was in sight at the end of the year than at the beginning, and a strike has just been made in new territory in the southeastern part of the property. Costs were held at a low point, in spite of high wages and high material costs. The new mill gave excellent results. The crude ore shipped during 1922 averaged 28.56 per cent lead, 41.41 oz. silver, 0.061 oz. gold, and 0.85 per cent copper. Lead concentrates averaged 26.13 per cent lead, 21.54 oz. silver, 0.053 oz. gold, and 0.26 per cent copper. Shipments for the first four months of 1923 were 10,483 tons of crude ore and 5,404 tons of concentrates, of about the same metallic content as the ore and concentrates shipped during 1922. M. J. Dailey was named to succeed himself as mine manager.

Park City M. & S.—Park-Utah

The Park City Mining & Smelting and the Park-Utah companies, both of Park City, and under the same management, during the first quarter of 1923 together produced 2,524 oz. gold, 1,470,430 oz. silver, 5,373,054 lb. lead, 572,152 lb. copper, 2,648,999 lb. of recoverable zinc, and 670,000 lb. spelter.

SOUTHEAST MISSOURI

Deepest Shaft Completed

The National Lead Co. has about completed its new shaft on the Pim land southeast of Elvins, which has been sunk under contract by the Longyear company. As this shaft is about 800 ft. deep, it is the deepest shaft in the district and develops a large, new, low-grade orebody. The output of this shaft will be hauled by rail to the mill at St. Francois, about 5 miles away.

New 500-Ton Mill Unit Planned

The Annapolis Lead Co., in Iron County, on the main line of the Iron Mountain R.R., is now regularly shipping concentrates to the Federal Lead Smelters at Alton, Ill. Plans are under way to add a second 500-ton unit to the present mill.

Ore Developed West of Irondale

A shaft is being sunk about 2 miles West of Irondale on Big River by W. J. Elledge and associates. It will open an orebody that was first developed by St. Louis parties about thirty years ago and again redrilled by New York interests three years ago. Though it seems to be a low-grade deposit, the drillings indicate a large body of ore at a depth of about 250 ft.

Turbine Replaces Old Engine

The Desloge Consolidated Lead Co. is about to equip its mill with a steam turbine, which, in addition to furnishing more power, will later replace a reciprocating engine that has been driving the mill for about thirty years.

MICHIGAN

By M. W. Youngs

Better Yield at Wolverine

Wolverine rock, which is stamped at the Mohawk mill, is now yielding 16 lb. per ton, which is 2 lb. better than formerly. The vein is being cut back to the footwall in No. 3 shaft, and good ground is being recovered from the 10th to the 17th levels and from the 22d to the 29th. The shaft pillars in No. 4 have been taken out as far up as the 22d level.

Franklin Will Resume—To Sink New Shaft

The Franklin Mining Co., whose property in the Michigan copper district has been idle for several years, has decided to resume operations immediately. The old shafts, however, will not be reopened at this time. A new shaft will be put down on the Kearsarge lode, the master vein of the district. The Kearsarge outcrops in Franklin territory, so the shaft can go right down into the vein without the necessity of sinking through a heavy overburden. An assessment of $1 per share, called by the directors, will provide sufficient funds for shaft sinking, inasmuch as all the machinery necessary for the work is already on the ground.

A theory of Thomas S. Woods, president of the company, will be applied in the new operations. The lode will be cut between two parallel cross-fissures, in line with his belief that the best copper values are to be found in such a zone. This theory is one which has worked out well in the producing mines of the district. The fissures are believed to have had an influence in the deposition of copper, and the location of the proposed Franklin shaft is on the line of the copper shoots found from surface downward in the New Baltic shaft of the Arcadian Consolidated.

Ahmeek's Crosscut to Osceola Lode Significant

The crosscut which Ahmeek is driving west of No. 2 shaft to penetrate the Osceola amygdaloid lode probably will reach its objective in July. Considerable interest attaches to this operation, as it will be the first time the vein has been opened so far to the north. In this connection, however, it is interesting to note that the lode was investigated by Wolverine, to the south of Ahmeek, some years ago. A shaft was sunk to the Osceola formation, 500 or 600 ft. in depth, and long drifts were driven into the vein. The results were negative. This, however, is no criterion as to what Ahmeek will find still farther to the north, as a lode may be barren or practically so in one stretch and have commercial values in another.

WASHINGTON

Smoke Farmer Asks $56,000; Gets $12,782

Damages of $12,782 has been granted John Ehorn by a decision of the Washington Supreme Court. Ehorn, a farmer, sued the Northwest Magnesite Co. for damages, claiming that his lands adjoining the calcining plant of the magnesite company near Chewelah were damaged by dust and his crops ruined. Ehorn sued for $56,000. The company has recently installed Cottrell precipitating equipment at the plant. This should obviate further trouble.

Copper Deposit To Be Drilled

The Mineral Creek Copper Co., developing a copper prospect near Easton, on Lake Kachess, is planning a diamond-drilling campaign to explore a large copper deposit that shows well on the surface. The surface showing accompanies a rhyolite intrusion about 100 ft. wide that will average about 5 per cent copper. The mineral is chalcopyrite.

MINNESOTA

$2,000,000 Construction Project Under Way

The Oliver Iron company has decided to erect a crushing plant to provide for the various properties of the company in the Hibbing district. As yet the final plans are not complete, but the construction work and necessary approaches including two new steel bridges will cost approximately $2,000,000. The location of the plant, which lies southwest of the village of Hibbing, has been selected primarily in an advantageous position to the Hull-Rust open pit, but it is also accessible to the other properties of this company. At present several of the company's properties have crushing and screening plants at the individual properties, which no doubt will continue to be used, but in case of necessity this ore can be handled at the new plant.

JOPLIN MIAMI DISTRICT

New Equipment at Lucky O. K.

After completely overhauling, the Lucky O. K. Mining Co. is reopening the Lucky Jenny property, in the Hockerville, Okla., district. The property will be known as Lucky O. K. No. 2. Two new gas engines have been installed to replace the old steam and electric equipment at the property. Considerable development work has been done in the mine, and operations will be carried on at 270 ft., and also at 235 ft.

Mill Burns

The Marquis-Ball concentrator, a mile west of Joplin, was completely destroyed by fire recently, with an estimated loss of $25,000. The mill had been idle for several years, but was said to be in good condition. It was owned by the Lindsey Lead & Zinc Co., made up of Ohio investors.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
24	15.00	41.75	42.50	7.25	7.05	6.45
25	14.75@15.00	41.625	42.25	7.25	7.05	6.35@6.40
26	14.50@15.00	41.50	42.25	7.25@7.30	7.05	6.35@6.40
28	14.50@14.75	41.125	41.75	7.25	7.05	6.35@6.40
29	14.50	41.50	42.25	7.25	7.05	6.35
30	.....	.....	.....	.....	....	.....
Av.	14.750	41.500	42.200	7.255	7.050	6.385

*These prices correspond to the following quotations for copper delivered: May 24th, 15.25c.; 25th, 15.00@15.25c.; 26th, 14.75@15.25c.; 28th, 14.75@15.00c.; 29th, 14.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. The quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

May	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
24	66⅞	67⅝	75½	199	193¾	26¼	25⅛	30¾	30⅜
25	65¾	66⅜	74½	199	199	26⅛	25⅛	30½	30⅛
28	65½	66⅛	73½	196¾	196½	25⅞	24⅞	30⅝	30⅛
29	65⅛	65⅝	73	197¾	197½	25⅞	24¾	30¾	30⅛
30	65⅜	66⅛	72½	199¾	199¾	25⅝	24⅞	31¼	30¾

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
24	4.62½	99⅛	66¾	32 9/16	28	4 62¼	99⅛	67⅛	32⅝
25	4.62⅜	99⅛	67	32⅝	29	4.62⅛	99⅛	66⅞	32½
26	4.62 7/16	99⅛	67⅛	32 11/16	30	....	....	....	32 9/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, May 29, 1923

Conditions continue extremely quiet in the non-ferrous metal market, and prices generally are stationary or decreasing. Consumption continues as great as ever, with practically all metal users operating their plants at as near capacity as labor conditions will permit, but the unfilled orders on their books are not so great as they were a few months ago. This is not so much because of an anticipated slackening in the demand for the ultimate product as to a feeling that commodity prices generally are likely to exhibit a downward trend and that it will be wise not to book orders for raw material farther ahead than necessary to insure deliveries in ample time for requirements. The decrease in metal prices in London is watched with a great deal of interest on this side, and the daily fluctuations, whether up or down, are reflected more in the domestic markets than formerly.

Copper

Copper has been practically unsalable all week, and the larger producers almost without exception have done little or no business. Offers have been made at constantly decreasing prices day by day without tempting consumers in the least. Most of the users of copper are supplied until July and feel that they can keep off the market for awhile longer; particularly in view of the fact that their advance orders are not so great as they were. Copper was sold up to and including Saturday at 15.25c., delivered, but since then offers at 15c. have been freely made, and second-hands anxious to sell have offered copper today as low as 14.50c., delivered, though this price is thought to be less than any producer would quote. Consumers seem to have decided to hold off buying until the market begins to advance. Then it is possible that a scarcity of July metal may develop. In every month of this year so far stocks of refined copper have declined, shipments from refineries being greater than refinery production, but it is thought likely that reports at the end of May will show an opposite condition. Production is not now increasing so fast as it was, but there is still potential capacity which is expected to come on to the market before the end of the year.

Forward copper is available from some sellers at substantially the same prices as prompt, for deliveries through the second half of the year.

Export demand continues quiet, with the Export Association holding for somewhat higher prices than independents, and the last-named therefore getting most of what little business there is.

Lead

The official contract price of the American Smelting & Refining Co. continues at 7.25c., New York.

Neither orders nor inquiries have been particularly numerous during the week, but the market continues firm. Specifications continue good, and contract orders are keeping the market bare of supplies, even though individual purchases are not quite so plentiful as formerly. Most of the producers are practically all sold out of June lead, and shipment for the first two weeks of the month is therefore commanding a premium of about 5 points. Smelters continue to operate as many furnaces as possible, and large accumulations of ore are reported at some points, owing to offerings of silver-lead ores before the expiration of the Pittman Act. A corresponding let-up in ore production by small operators is expected after this month.

The Chicago market is only about 2½ points above that at St. Louis at present, and lead has been obtainable in the Windy City at from 7.075 to 7.10c. all week.

Zinc

Sales have been lighter than usual. Inquiries showed a heavy fall, denoting a lack of interest in the market by galvanizers. It is the impression of producers that the activity of the galvanizers has been curtailed by a slump in their orders. The price of Prime Western has declined to 6.35c. for prompt shipment, with July-August metal obtainable at 6.30c. per lb. East St. Louis. Production of zinc continues unabated at a high rate. Whether the country can absorb the entire production remains to be seen. At present shipments are being made against old purchases, which gives the impression of a good industrial consumption.

High-grade metal business has been satisfactory, with prices ranging from 8.25 to 9c. per lb.—a wide spread. Producers are well sold out.

Tin

Demand has somewhat improved, and the price has been steadier during the last week. Tin-platers and alloy manufacturers have been in the market. Although forward metal has been quoted at about one-eighth cent above the price of spot during the week, this condition is not expected to continue, for there is little near-by tin in sight. The expected scarcity may be so pronounced that it will be necessary to import Straits tin from England.

Arrivals of tin, in long tons: May 24th, China, 25; 28th, Liverpool, 100; total so far in May, 5.590.

Gold

Gold in London: May 24th, 89s. 1d.; 25th, 89s.; 28th, 89s.; 29th, 89s. 2d.; 30th, 89s. 1d.

Foreign Exchange

German marks again set a new low record at over 61,000 to the dollar. On Tuesday, May 29, cable quotations on francs were 6.605c.; lire, 4.775c.; marks, 0.0016⅝c.; and Canadian dollars, 2 5/16 per cent discount.

Silver

The market has continued steady with fair demand from India and China.

Mexican Dollars—May 24th, 51; 25th, 51⅛; 26th, 51¼; 28th, 51¼; 29th, 51.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—General market for 99 per cent grade, 27½c. per lb.; 98 per cent, 26c. London £115.

Antimony — Chinese and Japanese brands, 7¼c. W.C.C., 8c. Cookson's "C" grade, spot, 10@10½c. Chinese needle antimony, lump, nominal, 5½c. per lb. Standard powdered needle antimony, 200 mesh, at 6@6½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 8@8½c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1 per lb. London, 5s.

Iridium—$265@$275 per oz.

Nickel—27@30c. per lb. for 99 per cent virgin metal. London, £130@£135 per long ton.

Palladium—$80@$81 per oz.

Platinum—$114 per oz. London, sponge, £22.

Quicksilver—$68 per 75-lb. flask. San Francisco wires $66.50. London, £10½.

The prices of **Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium** and **Tungsten** are unchanged from prices given May 5.

Metallic Ores

Chrome Ore—Indian chrome ore, $20.50 per ton, c.i.f. Atlantic ports. New Caledonian, $23@$25 per ton. Rhodesian, $20@$22.

Manganese Ore—40@45c. per long ton unit, seaport, plus duty.

Molybdenum Ore—75@85c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates plus duty.

Tungsten Ore—Wolframite, $8.25@$8.50; scheelite, $8.50@$9 per unit of WO_3, f.o.b. New York.

Iron Ore, Magnetite, Tantalum, Titanium, Uranium, Vanadium, and **Zircon Ore** are unchanged from the quotations published May 5.

Zinc and Lead Ore Markets

Joplin, Mo., May 26—Zinc blende, per ton, high, $42.40; basis 60 per cent zinc, premium, $38; Prime Western, $36@$37; fines and slimes, $35@$36; average settling price, all grades of blende, $38.37.

Lead, high, $109.95; basis 80 per cent lead, $90; average settling price, all lead ore, $106.95 per ton.

Shipments for the week: Blende, 11,965; lead, 2,010 tons. Value, all ores the week, $674,070. Shipments for five months: Blende, 301,856; calamine, 2,220; lead, 37,715 tons. Value, all ores five months, $17,683,260.

Purchases were 4,000 tons more than last week, smelting companies with subsidiary mining companies securing their increased tonnage of purchases from these. Ten or more of the companies, said to be producers of 50 per cent of the output, are reported banded together in refusal to accept less than a $40 basis price. Such organizations have in past years proved effective, and may again if market conditions will warrant a higher metal market.

Platteville market not received at the hour of going to press.

Non-Metallic Minerals

Asbestos—Crude No. 1, $500; No. 2, $250@$325; long spinning fibers, $135@$200; magnesia and compressed sheet fiber, $100@$150; shingle stock $65@$85; paper stock, $35@$42; cement stock, $20@$25; shorts, $9@$14—all per short ton, f.o.b. mines, Quebec, Canada.

Bauxite, Barytes, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and **Tripoli** are unchanged from the May 5 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13½c. per lb. for prompt. June-July, 12c. Second half 1923, 11c.

Copper Sulphate — Large crystals, 5.90c.; small, 5.80c.

Potassium Sulphate, Sodium Nitrate, and **Sodium Sulphate** are unchanged from quotations of May 5.

Ferro-Alloys

Ferromanganese — Domestic, 78@8. per cent, $125 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $40@$47, f.o.b. furnace; 16@19 per cent, $39@$45.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published May 5.

Metal Products

Copper Sheets—Base price, 24.25c per lb. Wire, 18¼@18½c.

Lead Sheets—Full lead, 10.25c. per lb.; cut lead, 10.50c.

Nickel Silver—30.25c. per lb. for 18 per cent grade A sheets.

Yellow Metal—Sheets, 21½c. per lb.; rods, 18.5c.

Zinc Sheets—Base price, $9.20 per 100 lb., with usual discounts and extras.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the May 5 prices.

The Iron Trade

Pittsburgh, May 29, 1923

The steel market has given an exhibition of fundamental strength in that it has not weakened in sympathy with the wave of unfavorable sentiment that has been seen in most business circles in the last few weeks. The customers of the steel industry are busy and give promise of being busy for several months to come. Deliveries of steel are well taken. Production of steel continues at approximately the high rate of thirty days ago, but will probably soon experience its usual hot weather decrease.

Prices for forward delivery are unchanged and are firm. Only in the oil trade is there any sign of steel consumption being lighter than expected. The dull season in automobile manufacture promises to be short.

Pig Iron—Prices are quotably lower by 50c. on bessemer, $1.50 on basic, and $1 on foundry, with inquiry still light but with better prospects of early buying, perhaps at further reductions. Bessemer, $29.50; basic, $27.50; foundry, $30, f.o.b. Valley furnaces.

Connellsville Coke—Spot dull and unchanged at $5@$5.25 for furnace and $6@$6.50 for foundry. Furnace men are slow to take hold for third quarter at the $6 price asked.

COMPANY REPORTS

Anaconda Copper Mining Co.

A report of the operations of the Anaconda Copper Mining Co. for 1922 shows a net income of $3,539,239.65, as follows:

Expense

Metals and manufactured products in process and on hand at beginning of year	$17,817,363.59
Ores and metals purchased	34,834,516.34
Mining, reduction, and refining of metals	31,659,049.58
Manufacturing expenses, including selling	76,280,220.60
Cost of merchandise sold and operation of public service companies	1,584,545.84
Administration and federal taxes	1,842,644.46
Balance carried down	11,432,044.06
	$175,450,384.47

Income

Sales of metals and manufactured products		$123,501,638.91
Tolls, royalties and rentals		5,973,914.50
Sales of merchandise and revenue of public service companies		2,302,038.52
Metals and manufactured products in process and on hand at end of year		43,672,792.54
		$175,450,384.47
Amount charged off this year for depreciation and obsolescence		2,988,043.85
Interest, including discount on bonds		4,020,344.49
Expenditure during suspension of operations		930,493.84
Balance, net income		
Apportioned to minority interests	$8,362.42	
	3,530,877.23	
		3,539,239.63
		$11,478,121.83
Balance brought down		11,432,044.06
Income from investments in sundry companies		46,077.77
		$11,478,121.83

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Fixed		
Mines and mining claims, coal mines, timber lands, phosphate deposits, water rights and lands for reduction works and refineries	$123,169,505.01	
Buildings and machinery at mines, reduction works, refineries, manufacturing plants, sawmills, foundries, water-works, and railroads	101,689,863.62	
Investments in sundry companies	18,553,002.71	
		$243,412,371.34
Deferred charges and discount on bonds		3,606,699.03
Current		
Supplies on hand, advances on ores and expenses prepaid	$19,258,305.45	
Metals and manufactured products in process and on hand—at cost	43,672,792.54	
Accounts receivable and cash assets	33,942,613.62	
		96,873,711.61
		$343,892,781.98

Liabilities

Capital stock of Anaconda Copper Mining Co.		
Authorized and issued—3,000,000 shares of $50 each		$150,000,000.00
Minority interests in subsidiary companies		3,781,412.70
Ten year secured gold bonds, due Jan. 1, 1929		
Authorized —$50,000,000.00		
Retired — 2,250,900.00		
Outstanding		47,749,100.00
Reserve for depreciation		27,025,771.13
Current		
Accounts and wages payable and taxes and interest accrued		44,051,713.67
Surplus		
Balance Dec. 31, 1921	$67,753,907.25	
Net income for the year ending Dec. 31, 1922	3,530,877.23	
		71,284,784.48
		$343,892,781.98

Operations at Butte were resumed on Jan. 16, gradually increasing during the year as the number of returning miners increased. There were mined 1,983,106.07 tons of ore and 7,571.95 tons of precipitates were produced.

At the concentrator there were treated 2,044,506.22 tons of ore, 81,154.90 tons of slimes from the ponds, 822,515.36 tons of copper tailings, and 91,920.83 tons of zinc-silver tailings.

The Anaconda Reduction Works treated for all companies 2,224,709.46 tons of ore. Of the total amount, 1,878,-162.56 tons of ore was produced by the mines of the company; 322,917.96 tons of ore was either purchased from or treated for other companies; and 23,628.94 tons of material was shipped from the old plants at Anaconda and Butte. No copper ores were treated at Great Falls.

Production of A. C. M. Co.'s Various Units

	Copper, Lb.	Silver, Oz.	Gold, Oz.
Anaconda smelter (*a*)	157,346,016	7,367,859	26,026.1
Great Falls refinery	140,901,359	.....	.....
Raritan refinery	300,284,594	8,086,858	33,873.5

	Zinc	Lead	Copper	Silver	Gold
	In pounds			In ounces	
Great Falls	113,475,088	15,211,699	1,937,696	3,373,386	5,674
International, Utah	.....	.....	10,879,094	825,030.6	7,281
International Lead plant	.....	20,271,23[illegible]	.....	1,860,806	4,297
Miami, Ariz.	.....	.....	188,113,444	477,347	5,82[illegible]
Int. Lead Ref.	.....	22,319,149	.....	1,486,553	3,750

(*a*) Of this production, 157,346,016 lb. of copper, 6,755,212 oz. of silver and 25,720 oz. of gold were for company account.

From the Butte mines of the company there was produced 87,076.08 wet tons of zinc ore. The plants at Anaconda and Great Falls treated 236,322.76 tons of ore and other zinciferous material. Of this amount, 93,240.55 tons was produced by the mines of the company, 632.79 tons of material was from the old plants at Butte, and 142,449.42 tons of ore and concentrates was purchased.

As a byproduct of copper smelter operations there was produced 3,036,347 lb. of arsenic, of which 3,007,599 lb. was refined, assaying more than 99 per cent arsenious oxide. Sales during the year amounted to 3,050,942 lb. at an average price of 7.1c. per lb., of which 224,684 lb. was crude and 2,826,258 lb. refined.

The mines at Conda, Idaho, produced 13,005.78 tons of rock, averaging 35 per cent P_2O_5. Of this amount 2,874.58 tons was sold and 10,131.20 tons shipped to Anaconda. The phosphate plant at Anaconda produced 2,413.11 long tons of treble superphosphate averaging approximately 45 per cent P_2O_5. The plant at present operated was built for the purpose of perfecting the process of manufacture, and has only a small capacity. Additions are now being made.

The pilot plant at East Chicago operated throughout the year, and produced 2,008,535 lb. of zinc oxide, all of which was sold at satisfactory prices. The construction of an operating unit of a French process oxide plant, consisting of twenty retorts having a daily capacity of approximately 16,000 lb. of zinc oxide per day, is practically completed.

At East Chicago, Indiana, there were produced 15,290,364 lb. of barreled white lead, and 79,721 lb. of pulp lead, all of which was sold. The plant is now operating on a basis of 25 tons daily.

At the various plants of the American Brass Co. there was produced 412,571,729 lb. of copper, brass and nickel-silver products. At the present time plants of the company are operating on a basis of 50,000,000 lb. monthly.

Magma Copper Co.

Copper; Superior, Ariz.

A report of the operations of the Magma Copper Co. for 1922 shows a net deficit of $701,762.18, as follows:

Sales of refined copper	$1,022,822.34
Less selling commission, freight, and storage	43,242.66
Net proceeds of sales	$979,579.68
Inventory value at Jan. 1, 1922, of copper sold	1,379,217.36
Loss on sales	$399,637.68
Add railway operating loss for year	36,721.10
	$436,358.78
General expenses, real estate, and corporate taxes	161,545.47
Interest on bonds, notes payable and amortization of bond discount	177,914.57
	$775,818.82
Deduct interest and other income earned	74,056.64
Net deficit for year	$701,762.18

Continued on page 1000

Magma Copper Co.—Continued

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Mining claims and development		$940,958.38
Mine and mill buildings and machinery, less depreciation		752,763.63
Smelter construction, expenditures to date		94,973.72
Narrow-gage railroad and equipment, less depreciation		236,937.15
Standard-gage railroad, expenditures to date	621,115.85	
		$2,646,748.73
Investments in controlled companies:		
Sacaton Copper Co.—49,000 shares	$60,043.07	
Patagonia Superior Copper Co.—250,003 shares	150,083.50	
Patagonia Superior Copper Co.—notes receivable	31,400.00	
		241,526.57
Investment: Apache Powder Co.		10,200.00
Current and working assets		2,452,225.50
Cash advances for power line construction repayable out of power supplied		36,564.58
Prepaid insurance and other expenses		2,490.46
Bond discount and expenses, less amortization		185,416.60
Mining and milling expenses during inoperative period of twenty-one months to Dec. 31, 1922		343,650.54
Total		$5,918,822.98

Liabilities

Capital stock		
Authorized 300,000 shares of no par value		
Issued 240,000 shares of no par value		$1,200,000.00
Ten-year 7 per cent convertible gold bonds due June 1, 1932		3,600,000.00
Current and accrued liabilities		217,245.03
Contingent reserve for claims		100,063.37
Surplus		
Balance as at Jan. 1, 1922	$1,503,276.76	
Deduct net deficit for year to Dec. 31, 1922	701,762.18	
		801,514.58
Total		$5,918,822.98

Production amounted to 990 tons of ore, averaging 7.03 per cent of copper, 4.08 oz. of silver, and .046 oz. of gold.

Alaska Juneau Gold Mining Co.

A report of the operations of the Alaska Juneau Gold Mining Co. for 1922 shows a loss of $144,538.20 according to the following account:

Dr.			
Mining		$452,873.64	
Milling		603,414.97	
Marketing concentrates and bullion		48,588.03	
Juneau and San Francisco general expense		59,751.96	
Storm-slide damage and settlements		35,257.24	
Bond-issue expense		178.11	
Bond interest		131,534.38	
Interest on note and loan accounts		39,428.17	
			$1,371,026.50
Cr.			
Bullion production (from amalgamation)		$1,025,878.69	
Gold recovery	$1,016,749.66		
Silver recovery	9,129.03		
Concentrates production		362,800.58	
Gold recovery	$279,407.29		
Silver recovery	39,960.83		
Lead recovery	43,432.46		
Liability insurance		4,329.16	
Assumed on payroll	$14,993.00		
Less cost of accident settlements	10,663.84		
Revenue from rents		159.50	
			$1,393,167.93
Net profit for year before main plant depreciation			$22,141.43
Deduct main plant depreciation			166,679.63
Net loss for year after depreciation			$144,538.20

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Property		$9,640,423.03
Mine development		2,015,595.28
Construction and equipment—main plant		3,356,513.31
Portable and underground equipment		53,412.84
Deferred charges to future operations		525,466.60
Supplies		304,951.16
Production in transit		131,676.37
Cash accounts		16,267.46
Sundry accounts receivable		3,415.12
Deficit in surplus account		876,894.73
		$16,924,615.90

Liabilities

Capital stock—authorized, 1,500,000 shares at $10		
Par value	$15,000,000.00	
Less unissued—100,000 shares	1,000,000.00	
		$14,000,000.00
Notes payable—6 per cent guaranteed note		390,000.00
Bond issue—7 per cent ten-year gold bonds, maturing March 15, 1929		1,894,000.00
Bond coupons due and not presented for payment, and interest		158,691.31
Bond interest—accruals after Sept. 15, 1922		39,191.85
Loan accounts and advances against current production		136,141.15
Payroll and accounts payable, and other liabilities		116,009.28
Depreciation reserve		190,582.31
		$16,924,615.90

The report states that the developed ore reserves justify the continuation of the mill rehabilitation work, and by the end of this year it is expected to have the over-all capacity of the milling plant brought up to 10,000 tons per day and its total operating costs, including sorting, brought down to 20c. per ton. This indicates that the sorting capacity of the milling plant will be brought up to 6,000 tons per day and its fine-grinding capacity brought up to 4,000 tons per day. The mill was originally designed to have a fine-grinding capacity of 8,000 tons per day, and efforts will be continued to approach this fine-grinding capacity and to correspondingly increase the over-all capacity of the milling plant.

Production in 1922 amounted to 2,310,550 tons. Expenditures totaled 62.67c. per ton, compared with 80.2c. for 1921.

Braden Copper Mines Co.

Copper; Chile

A report of the operations of the Braden Copper Mines Co. for the year ended Dec. 31, 1922, shows a loss of $5,698.02 as follows:

Operating revenue			
Copper sold and delivered—84,567,473 lb. @ 13.547c.			$11,456,641.15
Gold and silver			28,538.45
			$11,485,179.60
Operating cost			
Plant cost	$7,021,895.64		
Freight to seaboard	375,211.46		
Embarking, ocean freight, and insurance	295,741.13		
Refining	772,058.67		
Delivery and selling expenses	363,620.55		
		8,828,527.45	
Operating profit			$2,656,652.15
Other income			
Miscellaneous			36,995.14
Total income			$2,693,647.29
Charges against income			
Taxes and miscellaneous charges	$475.887.57		
Interest on bonds of Braden Copper Mines Co.	754,805.17		
Other interest (net)	1,468,652.57		
		2,699,345.31	
Net loss for year—carried to surplus account			$5,698.02

Combined Sstatement of Surplus Accounts

Deficit as stated—Dec. 31, 1921	$1,527,369.68	
Add additional capital stock taxes for years 1919 and 1920	51,472.00	
Deficit, Dec. 31, 1921—as adjusted		$1,578,841.68
Net loss for year—as above		5,698.02
		$1,584,539.70
Charges against surplus, 1922		
Depletion of ore reserves	$1,909,539.95	
Depreciation of equipment	1,866,195.83	
Loss on plant and equipment superseded	233,291.64	
Amortization of discount on bonds	128,461.56	
	$4,137,488.98	
Less discount on bonds purchased for retirement	31,683.50	
		4,105,805.48
Deficit Dec. 31, 1922		$5,690,345.18
Depletion reserve–Dec. 31, 1922		10,200,194.29
Net combined surplus and depletion reserve of Braden Copper Mines Co., and Braden Copper Co., Dec. 31, 1922		$4,509,849.11

Combined balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Property		$6,350,379.86
Construction and equipment	$36,583,208.51	
Less depreciation reserve	8,852,137.39	
		27,731,071.12
Deferred charges to mine development, including interest during development period		5,176,912.34
Investment—Sherman Steamship Co.		$575,480.13
Unamortized discount on bonds		1,027,692.22
Copper Export Association, Inc., suspense		486,475.75
Current and working assets		8,908,268.87
		$50,256,280.29

Liabilities

Capital stock issued—Braden Copper Mines Co.		$12,953,530.00
Bonds Issued—15-year 6 per cent sinking-fund gold bonds of Braden Copper Mines Co.		12,056,000.00
Kennecott Copper Corporation—loan account		16,712,691.47
Accounts payable—not due		683,050.02
Drafts payable—not due		1,953,043.41
Accrued interest		1,044,256.07
Miscellaneous		343,860.21
Net deficit from operations	$5,690,345.18	
Depletion reserve	10,200,194.29	
		4,509,849.11
		$50,256,280.29

Production amounted to 93,876,794 lb. of copper.

Bunker Hill & Sullivan Mining & Concentrating Co.

Lead, Silver; Kellogg, Idaho

A report of the operations of the Bunker Hill & Sullivan Mining & Concentrating Co. for 1922 shows a profit of $1,488,362.31, as follows:

		Per Ton Concentrates Produced	
Production costs (of 76,360.52 tons mill product)			
Mining—421,532 tons mined		$15.46	$1,180,693.31
Milling—430,219 tons mine ore		4.31	328,942.84
Shipping expense—76,519.91 tons concentrates shipped		.26	19,751.19
Smelting costs			
Freight, treatment, lead and silver discounts		24.08	1,838,685.02
Total production and marketing costs		$44.11	$3,368,072.36
Other costs			$329,602.08
Production revenue			
Gross lead and silver value of product shipped	$5,143,031.96		
Less concentrates inventory adjustment at cost	2,256.36		
		$67.32	$5,140,775.60
Less production and marketing costs		44.11	3,368,072.36
Mine operating profit—before depletion		$23.21	$1,772,703.24
Other revenue	$173,217.60		
Bunker Hill Smelter—net operating profit after depreciation	638,445.60		
	$811,663.22		
Less other costs	329,602.08		482,061.14
Operating surplus before depletion			$2,254,764.38
Deduct depletion for 1922			
Proportion normal surplus	$137,335.13		
Proportion revaluation surplus	421,442.51		558,777.64
Operating profit after depletion			$1,695,986.74
Deduct			
Income taxes accrued for 1922	$210,624.44		
Less overestimated for 1921	3,000.01		207,624.43
Balance for year to surplus accounts			$1,488,362.31

Analysis of Surplus

Normal surplus balance Dec. 31, 1921			$6,825,462.52
Operating surplus for 1922 before depletion		$2,254,764.38	
Less			
Proportion of 1922 depletion	$137,335.13		
Accrued income taxes, 1922	207,624.43	344,959.56	1,909,804.82
			$8,735,267.34
Deduct dividends paid in 1922			1,062,750.00
Balance Dec. 31, 1922			$7,672,517.34
Revaluation surplus			
Balance Dec. 31, 1921			35,313,625.59
Less proportion of 1922 depletion			421,442.51
Balance Dec. 31, 1922			$34,892,183.08
			$42,564,700.42

Balance sheet as of Dec. 31, 1922, is given as follows:

Property and Assets

Property and plant			$42,220,052.88
Less			
Depreciation charged off for year		$279,006.04	
Depletion charged off for year		558,777.64	837,783.68
			$41,382,269.20
Miscellaneous supplies			576,109.72
Ore accounts due			293,776.50
Products on hand			1,301,157.38
Investment reserve			1,269,064.35
Cash accounts			71,271.73
Outside investments			1,150,788.83
Miscellaneous mining stocks			156,573.70
Miscellaneous accounts receivable (including lead sales)			869,266.01
Employees' building loans			59,434.84
Other assets			
Deferred charges to future operations		$10,735.46	
Accrued interest on reserve investments		18,219.33	28,954.79
			$47,158,667.05

Capital and Liabilities

Capital stock—327,000 shares at $10 each	$3,270,000.00
Notes payable—Crocker National Bank	375,000.00
Mine and smelter drafts outstanding	208,738.09
Mine and smelter pay checks outstanding	72,791.01
Vouchers payable	71,823.31
Taxes reserve	38,558.69
Due lessees and other liabilities	14,034.72
Due Bunker Hill Smelter outside customers on concentrates and ores received and taken to stock	332,396.37
Normal surplus	7,672,517.34
Property revaluation surplus	34,892,183.08
Income taxes accrued	210,624.44
	$47,158,667.05

Production totaled 80,715,860 lb. of lead and 1,494,150 oz. of silver.

Facts for the Stockholder

XVIII—Nipissing Mines Co., Ltd.

NIPISSING MINES CO., Ltd., was incorporated in Ontario, July, 1917, taking over, through exchange of stock, the Nipissing Mines Co. of Maine. It is a holding company, and owns the entire capital stock of the Nipissing Mining Co., Ltd. In 1920, it purchased control of the Croton Magnetic Iron Mines, owning important iron mines at Brewster, N. Y., and estimated to contain 6,000,000 tons of commercial iron ore.

The property includes 846 acres of crown patent lands in the Cobalt district, Ontario, whereon it has developed over 100 fissure veins, from half an inch to a foot in width, carrying silver, cobalt, arsenic and nickel. In 1919, the company took an option on the Ophir Cobalt Mines, Ltd., which was dropped after development.

Development includes ten shafts, the deepest being a little over 1,000 ft. At present, operations are conducted through two main working shafts. During recent years, development work has been performed at the rate of 7,815 ft. in 1918, 7,717 ft. in 1919, 8,213 ft. in 1920, and 6,351 ft. in 1921. The work in 1921 included 2,221 ft. of drifting, 2,833 ft. of crosscutting, 1,259 ft. of raising, 37 ft. of sinking. Ore reserves are estimated at 1,444 tons of high-grade assaying 1,300 oz. silver, and 58,000 tons of low-grade assaying 19 oz. silver a ton. At the beginning of 1921, reserves were credited with 3,000,000 oz. silver, compared with 3,568,000 oz. in 1920.

Equipment includes a forty-stamp mill for low-grade ores, cyanide and flotation plants, and the necessary power plants.

Production in recent years has been at the rate of 70,000 to 80,000 tons per annum, assaying from 40 to 60 oz. silver a ton. Average content of ore mined in 1922 was 44 oz. of silver a ton. Production of silver in millions of ounces has been as follows: 4 in 1916, 4.2 in 1917, 3.7 in 1918, 2.9 in 1919, 3.3 in 1920, 3.1 in 1921, 3.4 in 1922. The estimated value in millions of dollars of the ore produced in recent years is as follows: 3.5 in 1918, 3.1 in 1919, 3.4 in 1920, 2.2 in 1921, 2.26 in 1922. The value of the production in the first quarter of 1923 was about $539,000. Total production of the mines since 1904 is estimated at 66,000,000 oz. having a net value of over $40,000,000.

Cost of production per ton of ore was as high as $17.74 in 1918, and as low as $11.16 in 1921. Treatment cost per ton of low-grade ore was $5.39 in 1917, and $4.60 in 1921. Cost of production per ounce of silver was 39c. in 1918, and reduced to 28.53c. in 1921. In 1922 this cost was increased 4.4c. an ounce. Extraction from low-grade ore was increased from 80 per cent in 1918 to 94 per cent in 1921.

Capital stock consists of 1,200,000 shares, par value $5. There is no funded debt. Number of stockholders on Jan. 20, 1923, was about 13,500.

Earnings per share of stock of the holding company have been as follows: $1.73 in 1912, $1.37 in 1913, $1.31 in 1914, $1.17 in 1915, $1.65 in 1916, $2.24 in 1917, $2.10 in 1918, $2.31 in 1919, $1.07 in 1920, $0.80 in 1921, and $1.24 in 1922.

Dividends paid since organization have been as follows: 8 per cent in 1906, 14 in 1907, 12 in 1908, 22½ in 1909, 35 in 1910, 30 in 1911-12-13, 22½ in 1914, 20 in 1915, 25 in 1916, 30 in 1917-18-19-20, 19 in 1921, and 18 per cent in 1922. The present rate is 12 per cent, or 60c. a share, per annum, payable quarterly, plus extras.

Current assets on Dec. 31, 1922, were $4,647,085, compared to $4,177,403 in 1921. Net working capital is about $4,000,000. At the end of 1922, net assets applicable to common stock amounted to about $8.70 a share. In March, 1923, the operating company reported cash and investments amounting to $3,941,000, and ore and bullion in transit and in process valued at $633,000.

Price range of stock on New York Curb during the last few years has been as follows: High, 15 in 1912, low, 4 in 1921; closing price 5⅝ May 28, 1923. INVESTIGATOR.

Freight Rates on Metals, Ores, and Concentrates

In Carload Lots

Freight Rates on Copper Bullion and Refined Copper

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
El Paso, Tex.	Baltimore, Md.	$13.40	.....
Garfield, Utah	Perth Amboy, N. J.	16.50	.....
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy, N. J.	16.50	$14.50
Miami, Ariz.	Perth Amboy, N. J.	16.50	14.50
Anaconda, Mont.	Perth Amboy, N. J.	16.50	.....
Butte, Mont.	Perth Amboy, N. J.	16.50	.....
Humboldt, Ariz.	Chrome, N. J.	16.50	14.50
Douglas, Ariz.	Perth Amboy, N. J.	16.50	14.50
Globe, Ariz.	Perth Amboy, N. J.	16.50	14.50
Clifton, Ariz.	Perth Amboy, N. J.	16.50	14.50
Clarkdale, Ariz.	Chrome, N. J.	16.50	14.50
Copperhill, Tenn.	Laurel Hill, N. Y.	10.80	.....
Tooele, Utah	Chrome, N. J.	16.50	.....
McGill, Nev.	Baltimore, Md.	15.90	.....
Houghton, Mich.	New York	(a) 9.60	.....
Hancock, Mich.	New York	(a) 9.60	.....
Hubbell, Mich.	New York	(a) 9.60	.....
Dollar Bay, Mich.	New York	(a) 9.60	.....
Tacoma, Wash.	New York (water)	Around $4.00	
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	16.50	14.50

(a) Applies April 1 to Nov. 30 of each year.

Lead Bullion; Also Pig Lead Where Shown

From	Rates per Ton of 2,000 Lb. To New York	To St. Louis
East St. Louis, Ill.	$7.00	.....
Pueblo, Colo.	14.15	$9.65
Leadville, Colo.	16.50	11.40
East Helena, Mont.	16.50	11.40
El Paso, Tex. (domestic)	12.00 Via Gulf	
	(c) 14.00 All Rail	(b) 7.76½
Omaha, Neb.	9.60	3.65
Murray, Utah	16.50	11.40
Midvale, Utah	16.50	11.40
Tooele, Utah	16.50	11.40
East Chicago, Ill.	6.40	(a) 2.00
Kellogg, Idaho	16.50	11.40
Carnegie, Pa.	3.80	(a) 5.00
Selby, Calif.	Around $4.50 via Canal	
Herculaneum, Mo.	(a) 8.80	(a) 1.80
Federal, Ill.	7.00	(a) 1.80
Collinsville, Ill.	7.00	(a) .75½
Granby, Mo.	(a) 10.50	(a) 3.50
Joplin, Mo.	(a) 10.50	(a) 3.50

(a) Pig lead only.
(b) Pig lead only when originating in Mexico.
(c) Shipments of bullion originating in Mexico, $2 per ton less.

Zinc

From	Rates per Net Ton To East St. Louis	To New York
Donora, Pa.	(a) $4.60	$3.80
Langeloth, Pa.	(a) 4.60	3.80
Palmerton, Pa.	*7.10	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	2.00	6.40
La Salle, Ill.	2.00	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	6.40
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	14.50
Park City, Utah	11.40	16.50
Canyon City, Colo.	15.55	22.55

(a) To St. Louis, Mo.

Zinc Ores and Concentrates to Oklahoma Smelters

Commodity	To	From	Rate per Net Ton
Zinc ore and concentrates, carloads	Bartlesville, Okla.	Altoona, Kan.	$2.10
		Pittsburg, Kan.	*1.10
		Galena, Kan.	1.30
		Joplin, Mo.	1.40
		Iola, Kan.	1.80
		Baxter, Kan.	1.40
		Miami, Okla.	1.40
		Quapaw, Okla.	1.40
		Kansas City, Mo.	1.60
		Miami, Okla.	2.20
		Quapaw, Okla.	2.20
Zinc ore and concentrates, carloads	Sand Springs, Okla.	Galena, Kan.	1.50
		Joplin, Mo.	1.50
		Iola, Kan.	2.40
		Cave Springs, Mo.	2.00
		Cent City Spur, Mo.	2.00
Zinc ore and concentrates, carloads	Dewar, Okla.	Chitwood, Mo.	2.00
	Kusa, Okla.	Galena, Kan.	1.50
	Henryetta, Okla.	Iola, Kan.	2.40
		La Harpe, Kan.	2.40
		Mound City, Kan.	.50
Zinc ore and concentrates, carloads	La Harpe, Kan.	Oswego, Kan.	.50
		Parsons, Kan.	.50
Zinc ore and concentrates, carloads	Coffeyville, Kan.	Galena, Kan.	1.10
		Joplin, Mo.	*1.22
Lead ore and concentrates, carloads	Bartlesville, Okla.	Baxter, Kan.	1.80
		Miami, Okla.	1.80
		Quapaw, Okla.	1.80

Rates on Ores and Concentrates

From	To	Value of Product $5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate														
Butte, Mont.	Anaconda, Mont.	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	17	.17	.17	.17
Butte, Mont.	Black Eagle, Mont. (a)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	....	....	....	....	....	....	....
Great Falls, Mont.	East Helena, Mont.	....	....	1.50	....	....	....	1.91	....	2.36	....	....	....	....	....	2.48
Butte, Mont.	East Helena, Mont.	....	....	1.17	....	1.46	....	1.69	....	2.03	....	....	....	....	....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah (b)	....	....	....	....	....	....	....	....	6.30	7.00	7.70	....	8.40	9.10	9.80
Johannesburg, Calif.	Selby, Calif.	....	....	....	3.40	....	4.10	....	4.80	5.50	6.20	6.90	....	7.60	8.00	8.30
Johannesburg, Calif.	Humboldt, Ariz.	....	....	....	3.40	....	4.10	....	4.80	5.50	6.20	6.90	....	7.60	8.00	8.30
Pioche, Nev.	Humboldt, Ariz.	....	....	7.74	....	8.55	....	9.36	....	9.99	....	....	11.25	....	....	12.42
Creede, Colo.	Durango, Colo.	....	....	3.25	3.50	3.75	4.00	....	4.25	4.75	5.25	5.75	6.05	....	....	7.10
Ouray, Colo.	Durango, Colo.	....	....	4.30	4.80	....	5.05	....	....	5.90	....	6.30	....	....	....	7.70
Kokomo, Colo.	Durango, Colo.	....	6.00	....	....	6.50	7.20	....	....	....	....	....	....	....	....	....
Telluride, Colo.	Durango, Colo.	....	....	....	....	....	4.30	....	5.00	5.90	6.30	6.30	....	....	....	7.70
Silverton, Colo.	Durango, Colo.	....	....	1.40	1.40	....	....	2.20	....	....	2.30	2.55	....	2.80	....	2.80
Tyrone, N. M.	Douglas, Ariz.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	....	3.40	....	....	3.80
Tyrone, N. M.	El Paso, Tex.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	....	3.40	....	....	3.80
Lordsburg, N. M.	Douglas, Ariz.	....	1.00	1.30	1.60	....	1.90	....	2.00	2.00	....	....	2.80	....	....	3.40
Lordsburg, N. M.	El Paso, Tex.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Tombstone, Ariz.	Douglas, Ariz.	....	....	.60	....	.90	....	....	....	1.30	....	....	1.60	....	....	1.90
Tombstone, Ariz.	El Paso, Tex.	....	....	1.90	....	2.50	....	....	....	3.80	....	....	4.40	....	....	4.40
Silver City, N. M.	Douglas, Ariz.	....	....	2.48	....	3.15	....	....	....	3.83	....	....	....	....	....	5.29
Ray Junction, Ariz.	Hayden, Ariz.	....	.10	....	.40	....	.50	....	.80	.90	....	....	1.00	....	....	1.10

(a) Minimum tonnage of 500 tons per day. (b) In open cars, minimum 80,000 lb.

Rates on Ores and Concentrates

From	To	Value of Ores and Concentrates $10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate													
Burke, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.68	....	....	....	....	1.02
Burke and Wallace, Idaho	East Helena, Mont.	....	....	....	....	3.00	....	3.25	3.50	3.75	4.00	.....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.	....	....	....	3.38	....	3.83	....	4.16	....	....	....	....	....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.35	....	....	....	....	.50
Bayview, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	3.75	....	....	4.37½	....	....	5.12½
Park City, Utah	Salt Lake Smelters	1.00	1.10	1.25	....	1.50	....	1.75	....	2.00	....	.....	2.25	....	2.50
Eureka, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters	1.00	....	1.25	1.50	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah	....	.40	....	.75	....	....	....	.95	....	....	1.10	....	....	1.25
Cherry Creek, Nev.	Garfield, Utah	....	....	4.60	....	5.10	....	5.60	6.10	6.60	7.10	.....	7.60	8.10	8.60
Goldfield, Nev.	Salt Lake Smelters	....	....	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Battle Mountain, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Palisade, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Mina, Nev. (a)	Salt Lake Smelters	....	....	3.60	....	4.30	....	5.00	5.70	6.40	7.10	.....	7.80	8.50	9.20
Lovelock, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Golconda, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Hazen, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Tonopah, Nev.	Salt Lake Smelters	....	....	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Rogerson, Idaho	Salt Lake Smelters	3.00	....	3.50	....	4.00	....	4.50	5.00	5.50	6.00	.....	6.50	7.00	7.50

(a) Minimum weight, marked capacity of car used, but not less than 80,000 lb.
*Indicates a change of tariff since last report.

MINING STOCKS

Week Ended May 26, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	72	67	70½	Mar. 23, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2⅜	2	2⅜		
Allouez	Boston	24½	22	24½	Mar. '19	1.00
Anaconda	New York	46¼	43⅞	46¼	Apr. '23, Q	0.75
Arcadian Consol.	Boston	2 1/16	2	2		
Ariz. Com'l.	Boston	11¼	9⅞	10⅛	Oct. '18, Q	0.50
Calaveras	N. Y. Curb	3	3	3		
Calumet & Arizona	Boston	53½	51⅝	53½	Mar. '23,	1.00
Calumet & Hecla	Boston	383	365	380	Mar. '23, Q	7.00
Centennial	Boston			9½	Dec. '18, SA	1.00
Cerro de Pasco	New York	44⅜	41½	44	May '23,	1.00
Chile Copper	New York	27⅞	26½	27⅛	Mar. 23,	0.62½
Chino	New York	23⅜	21¼	23⅜	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	3⅜	2⅞	3⅛		
Copper Range	Boston	36	34¼	34¾	May '23, Q	1.00
Crystal Copper	Boston Curb	1⅜	1¼	1¼		
Davis-Daly	Boston	3⅜	2⅞	3	Mar. '20, Q	0.25
East Butte	Boston	7½	7	7⅛	Dec. '19, A	0.50
First National	Boston Curb	48	40	45	Feb. '19, SA	0.15
Franklin	Boston	*90	*30	*50		
Gadsden Copper	N. Y. Curb	*80	*80	*80		
Granby Consol.	New York	25⅞	22½	25½	May '19, Q	1.25
Greene-Cananea	New York	25½	21¼	23¼	Nov. '20, Q	0.50
Hancock	Boston			2½		
Howe Sound	N. Y. Curb	3½	3½	3½	Jan. '21, Q	0.05
Inspiration Consol.	New York	34⅝	32⅜	34⅛	Apr. '23, Q	0.50
Iron Cap	Boston Curb	6	5½	5⅞	May 23, K	0.15
Isle Royale	Boston	25	22	25	Mar. '23, Q	0.50
Kennecott	New York	38	34⅛	37½	Apr. '23, Q	0.75
Keweenaw	Boston	1⅜	1¼	1⅜		
Lake Copper	Boston	3⅜	3⅛	3⅛		
Magma Copper	New York	34	30½	33½	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2	1⅝	2		
Mass Consolidated	Boston			1½	Nov. '17, Q	1.00
Miami Copper	New York	26⅜	25⅜	26⅛	May '23, Q	0.50
Michigan	Boston			1½		
Mohawk	Boston	53½	49	53	Mar. '23, Q	1.00
Mother Lode Coa.	New York	10⅛	9½	10	Mar. '23, K	0.50
Nevada Consol.	New York	14⅜	13⅛	14⅛	Sept. '20, Q	0.25
New Cornelia	Boston	19⅜	17¼	18⅛	May '23, Q	0.25
North Butte	Boston	8¼	7⅛	7¼	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*68	*46	*67		
Old Dominion	Boston	23⅜	23⅛	23⅛	Dec. '18, Q	1.00
Osceola	Boston	35	31⅜	34¼	Mar. '23, K	1.00
Phelps Dodge	Open Mar.	†185	†175		Apr. '23, Q	1.00
Quincy	Boston	36	32	35½	Mar. '20, Q	1.00
Ray Consolidated	New York	13⅜	12⅛	13⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅜	1⅛	1⅜		
St Mary's Min. Ld.	Boston	41	37⅛	41	Mar. '23, K	3.00
Seneca Copper	New York	8¼	7⅜	8¼		
Shannon	Boston	*71	*70	*70	Nov. '17, Q	0.25
Shattuck Arizona	New York	7⅜	7	7⅛	Jan. '20, Q	0.25
South Lake	Boston	*45	*45	*45		
Superior & Boston	Boston	1⅜	1⅜	1⅜		
Tenn. C. & C. cfs.	New York	10⅛	9⅞	10⅛	Apr. '23, Q	0.25
Tuolumne	Boston	*35	*30	*35	May '13,	0.10
United Verde Ex.	N. Y. Curb	34	32	32½	May '23, Q	1.00
Utah Consol.	Boston	2	1⅞	1⅞	Sept. '18,	0.25
Utah Copper	New York	66½	61⅛	66	Mar. '23, Q	1.00
Utah Metal & T.	Boston	*90	*85	*85	Dec. '17,	0.30
Victoria	Boston			1⅛		
Winona	Boston			*90		
Wolverine	Boston	8⅛	7⅛	8⅛		
NICKEL-COPPER						
Internat. Nickel	New York	14½	13⅜	13½	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	79	79	79	May '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	4	4	4		
National Lead	New York	119	111½	119	Mar. '23, Q	2.00
National Lead, pfd.	New York	112	110½	112	Mar. '23, Q	1.75
St. Joseph Lead	New York	19½	18	19½	Mar. '23, Q,X	0.50
ZINC						
Am. Z. L. & S.	New York	14½	10⅛	14½	May '20,	1.00
Am. Z. L. & S. pfd.	New York			48	Nov. '20, Q	1.50
Butte C. & Z.	New York	7⅛	6½	7	Mar. '23,	0.50
Butte & Superior	New York	25⅛	20⅛	25½	Mar. '23, Q	0.50
Callahan Zn-Ld	New York	7⅛	6	7⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	161½	160	161½	May '23, Q	2.00
United Zinc	N. Y. Curb			1¼		
Yellow Pine	Los Angeles	*60	*60	*60	Sept. '20, Q	0.03
SILVER						
Alvarado	N. Y. Curb			5		
Batopilas Mining	New York	⅜	⅜	⅜	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*39	*37	*39	May '20, K	0.03
Candelaria	N. Y. Curb	*11	*7	*9		
Castle-Trethewey	Toronto	*25½	*24	*25½		
Coniagas	Toronto	2.90	2.85	2.90	May '21, Q	0.12½
Crown Reserve	Toronto	*72	*60	*72	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb	1⅜	1 1/16	1⅛		
Kerr Lake	N. Y. Curb	2⅛	2⅛	2⅛	Apr. '23, Q	0.12½
La Rose	Toronto	*36	*33½	*34½	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*19½	*18	*18½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	2.90	2.70	2.90	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅛	5⅛	5⅛	Apr. '23, Q	0.15
Ontario Silver	New York	5	5	5	Jan. '19, Q	0.50
Temiskaming	Toronto	*41	*40	*40	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Boundary Red M.	N. Y. Curb	*35	*30	*30		
Carson Hill	Boston	6½	5½	6½		
Cresson Consol. G.	N. Y. Curb	3 1/16	3	3⅛	Apr. '23 Q	0.10
Dome Mines	New York	39	30⅞	38½	Apr. '23, Q	0.50
Golden Cycle	Colo. Springs	1.11	1.10	1.11	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	12.25	12.00	12.10	May '23, M	0.05
Homestake Mining	New York	63	60	62	May '23, M	0.50
Kirkland Lake	Toronto	*51	*47	*51		
Lake Shore	Toronto	3.36	3.20	3.36	May '23, Q	0.02
McIntyre-Porcupine	New York	18⅞	16⅞	18⅞	May '23, Q	0.25
Portland	Colo. Springs	*40	*38½	*38½	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1⅜	1⅛	1⅜		
Tom Reed	Los Angeles	*80	*73	*73	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 1/16	1⅛	1 1/16	Apr. '23, Q	0.15
Vipond Cons.	Toronto	*71	*68	*71		
White Caps Mining	N. Y. Curb			*6		
Wright-Hargreaves	Toronto	3.40	3.30	3.40	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb	1⅜	1⅜	1⅜	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*18	*15	*15		
Cons. Virginia	San Francisco	10⅛	9⅛	10⅛		
Continental Mines	N. Y. Curb	4⅛	4⅛	4⅛		
Dolores Esperanza	N. Y. Curb	1⅛	1⅛	1⅛	Apr. '23	0.05
Jib Consol.	N. Y. Curb	1	*95	*95		
Tonopah Belmont	N. Y. Curb	*98	*95	*98	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*61	*55	*60		
Tonopah Extension	N. Y. Curb	2 1/16	1 1/16	2	Jan. '23, Q,X	0.10
Tonopah Mining	N. Y. Curb	1⅜	1⅜	1⅜	Apr. '23, Q	0.07½
Unity Gold	N. Y. Curb	4⅛	4⅛	4⅛		
West End Consol.	N. Y. Curb	*98	*90	*97	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	18	16½	18	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*69	*66	*66	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅛	4	4⅛	May '23, Q	0.10
Columbus Rexall	Salt Lake	*47½	*45	*47½	Aug. '22,	0.03
Consol. M. & S.	Montreal	26½	25	25½	Oct. '20, Q	0.62½
Federal M. & S.	New York	8½	8	8	Jan. '09,	1.50
Federal M. & S. pfd.	New York	46	44½	44½	Mar '23, Q	1.75
Florence Silver	Spokane	*38	*38	*38	Apr. '19, Q,X	0.01½
Hecla Mining	N. Y. Curb	8⅛	8	8	Mar. '23,	0.25
Iron Blossom Con.	N. Y. Curb	*32	*31	*31	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*16	*14	*15	June '21, I	0.02
Park City	Salt Lake	3.20	3.20	3.20	Apr. '23,	0.12½
Park Utah	N. Y. Curb			3⅜	Apr. '23	0.15
Prince Consol.	Salt Lake	*8	*4	*5½	Nov. '17,	0.02½
Silversmith	Spokane	*42½	*41	*41	Apr. 23,	0.01
Simon Silver Lead	N. Y. Curb	*31	*30	*31		
Snow Storm Silver-L	N. Y. Curb	1	*98	1		
Tamarack-Custer	Spokane	1.35	1.30	1.32	Jan. '21, K	0.04
Tintic Standard	Salt Lake	3.05	2.95	3.05	Dec. '22, Q,X	0.10
Utah-Apex	Boston	4⅛	4⅛	4⅛	Nov. '20, K	0.25
IRON						
Bethlehem Steel	New York	56	51⅜	54⅜	Apr. '23, Q	1.25
Char. Iron	Detroit	1⅜	1	1		
Char. Iron, pfd	Detroit	2⅛	2⅛	2⅛		
Colorado Fuel & Iron	New York	31⅛	27	31	May '23, Q	2.00
Col. Fuel & Iron, pfd.	New York			102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	29½	27½	29½	Apr. '23	1.00
Inland Steel	N. Y. Curb			46½	Mar. '23	0.25
Mesabi Iron	N. Y. Curb			9		
Replogle Steel	New York	21½	19	21½		
Republic I. & S.	New York	52⅜	46½	52⅛	May '21	1.50
Republic I. S., pfd.	New York	95½	94⅛	94⅛	Apr. '23	1.75
Sloss-Sheffield S. & I.	New York	53	49	53	Feb. '21	1.50
Sloss-Shef. S.&I., pfd.	New York			81	Apr. '23	1.75
U. S. Steel	New York	99⅛	95	99⅛	Mar. '23, Q	1.25
U. S. Steel, pfd	New York	118⅛	117⅜	118	May '23	1.75
Virginia I. C. & C.	New York	60	59⅛	59⅛	Jan. '22	1.50
Virginia I.C.&C.,pfd.	New York			83	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	33⅛	30	33⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	62⅛	62	62⅛	Apr. '23 Q	1.50
Asbestos Corp. pfd.	Montreal			84	Apr. '23 Q	1.75
SULPHUR						
Freeport Texas	New York	15	12⅛	15	Nov. '19, Q	1.00
Texas Gulf	New York	63	59⅛	62⅛	May '23, Q	1.50
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3	2⅛	2⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	46⅛	44⅛	46	Mar. '23, Q	0.75
Amer. Metal pfd.	New York			114	Mar. '23, Q	1.75
Amer. Sm. & Ref.	New York	60⅛	53⅛	60⅛	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	98⅛	96⅛	97⅛	Mar. '23 Q	1.75
U. S. Sm. R. & M.	New York	30⅛	29	30⅛	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	44	43⅛	43⅛	Apr. '23 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

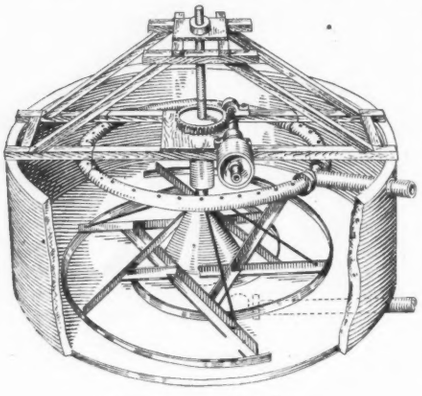
Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

Vandercook Mercuric-Cyanide System of Ore Treatment

BY M. J. CONOVER

The 50-ton cyanide plant built by the A. E. Vandercook Engineering Co. of Sacramento, Calif., for the Bobby Mining Co., of Cathay, Mariposa County, Calif., was put in operation on Feb. 21. The initial thirty days' run was made under my supervision, representing the A. E. Vandercook Engineering Co. The results were satisfactory, both from the standpoint of extraction and the efficiency of the Vandercook thickeners and classifier.



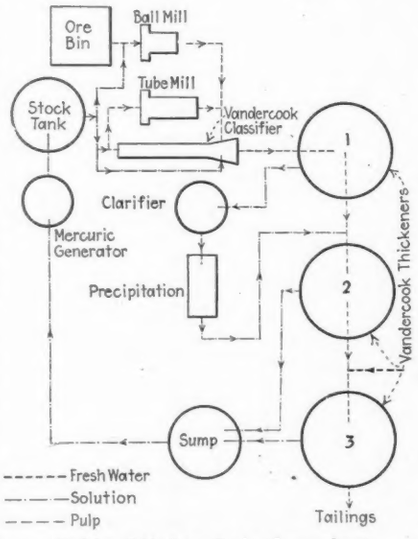
Vandercook thickener

New ideas, chemical and mechanical, are put into successful operation under this system of treatment of gold and silver ores; the results at the Bobby mine mark an advance in simplicity over straight cyanidation. The ore is highly siliceous and heavy in pyrite and arsenopyrite. Gold is the principal product; it occurs mechanically combined on the cleavage planes of the sulphides. The value of the ore treated was from $6 to $8 per ton.

Ores of this character cannot be treated by straight cyanidation; the formation of alkaline sulphides and thiocyanates renders the solution so foul that dissolution of the gold and silver is retarded. The mercuric-cyanide prevents this and acts as a supersolvent and desulphurizer at the moment of the formation of alkaline sulphides or thiocyanates. A couple is obtained by what is known as a mercuric generator, which is placed in the mill circuit at a point where barren and mill solutions may be treated before being returned to the stock tank. The solution is circulated in the mercuric generator by means of a centrifugal pump, into the suction of which atmospheric air is introduced, insuring complete aeration, as well as oxidizing the surface of a bath of mercury placed in the bottom of the apparatus. The mercuric oxide thus formed, being easily dissolved, is taken up quickly by the cyanide solution. The amount of mercury that goes into solution is small, but is sufficient to act as a supersolvent and desulphurizer. Although it has not been fully demonstrated, I believe that the nitrogen introduced thus into the solution tends to regenerate cyanogen, which would account partly for the low cyanide consumption shown throughout the thirty days' test run.

Primary grinding at the Bobby mine is done in a 4x5-ft. ball mill, to minus 40 mesh. The discharge goes direct to a Vandercook classifier (drag type), the oversize passing to a 4x10-ft. tube mill, where it remains in closed circuit with the classifier until 90 to 95 per cent will pass 100 mesh.

The extraction at the classifier overflow averaged 85 per cent during the run. The dilution entering No. 1 thickener averaged 9 parts of solution to 1 part of solids. Decantation from No. 1 thickener goes direct to precipitation, and the barren solution from the zinc boxes is taken to No. 2 thickener, acting as a wash, which tends to decrease the dissolved gold per ton of solution in No. 2 thickener. The decanted solution from No. 2 thickener goes to the sump, after which it passes through the mercuric generator and is then taken to the stock tank. The underflow from No. 1 and No. 2 thickeners is maintained at 50 per cent solids, and the underflow from No. 3 thickener, the tailing, at 60 to 75 per cent solids. Sufficient fresh water is added to No. 3 thickener to replace the absorption loss in the tailing; this also acts as a wash. The decanted solution from this thickener goes to the sump. Maximum cyanide consumption and absorption loss amounted to 1½ lb. of sodium cyanide per ton of ore. The strength of the stock solution was kept at 2 to



Bobby Mining Co.'s flow sheet

2½ lb. of sodium cyanide per ton of solution. Alkalinity (as CaO) was kept between 1.2 and 1.8 lb. per ton of solution.

The precipitation in the zinc boxes was excellent. It made no difference whether the pregnant solution assayed 15c. or $1 per ton of solution: the zinc-box effluent remained from 1 to 5c. per ton. Lead acetate was unnecessary; the solutions were always clean, in consequence of the action of the mercuric cyanide couple.

At the beginning of the test run it was decided to omit the mercuric generator from the cycle, and to operate by straight cyanidation. An extraction varying from 91.04 to 92.8 per cent was obtained during the first five days. The solutions then began to foul, and at the end of the next three days the extraction dropped to 71.6 per cent. The mercuric generator was then put into the cycle, and better extraction was obtained. In the next six days the extraction was brought gradually up to 92.9 per cent, which was maintained to the completion of the test run.

INDUSTRIAL NOTES

The Traylor Engineering & Manufacturing Co. announces that W. C. MacDowell, formerly manager of the mining sales department of the power and mining machinery works of the Worthington Pump & Machinery Corporation, has joined its organization as general sales manager.

E. G. Markley, who for the last seventeen years has been secretary and purchasing agent for S. Flory Manufacturing Co., Bangor, Pa., manufacturers of hoisting engines, cableways and marine auxiliaries, was recently appointed general manager of the company.

TRADE CATALOGS

Drafting Supplies — "Blue-Printing Machinery, Blue Printing and Accessories" is the title of a new publication put out by the C. F. Pease Co., 823 North Franklin St., Chicago. Detailed information is given regarding equipment and methods used in the modern drafting room. A copy will be mailed upon request.

Flotation—The Jones-Belmont flotation machine is described in Bulletin 1822, issued by the mining machinery department of the Allis-Chalmers Manufacturing Co. Cells of sheet-steel and concrete-steel construction are described.

Ore Cars—The Coeur d'Alene Hardware & Foundry Co., Wallace, Idaho, has issued Bulletin No. 71, describing the standard end- or side-dump Coeur d'Alene car, a prospector's car, the Ajax side-dump car, and the Coeur d'Alene and the Hecla bottom-dump cars.

Magnetic Pulleys—"High intensity" magnetic pulleys, ranging in capacity from 600 to 12,000 cu.ft. per hour, are described in Bulletin No. 25-P, May, 1923, issued by Dings Magnetic Separator Co., Milwaukee, Wis. Instructive information and illustrations are given.